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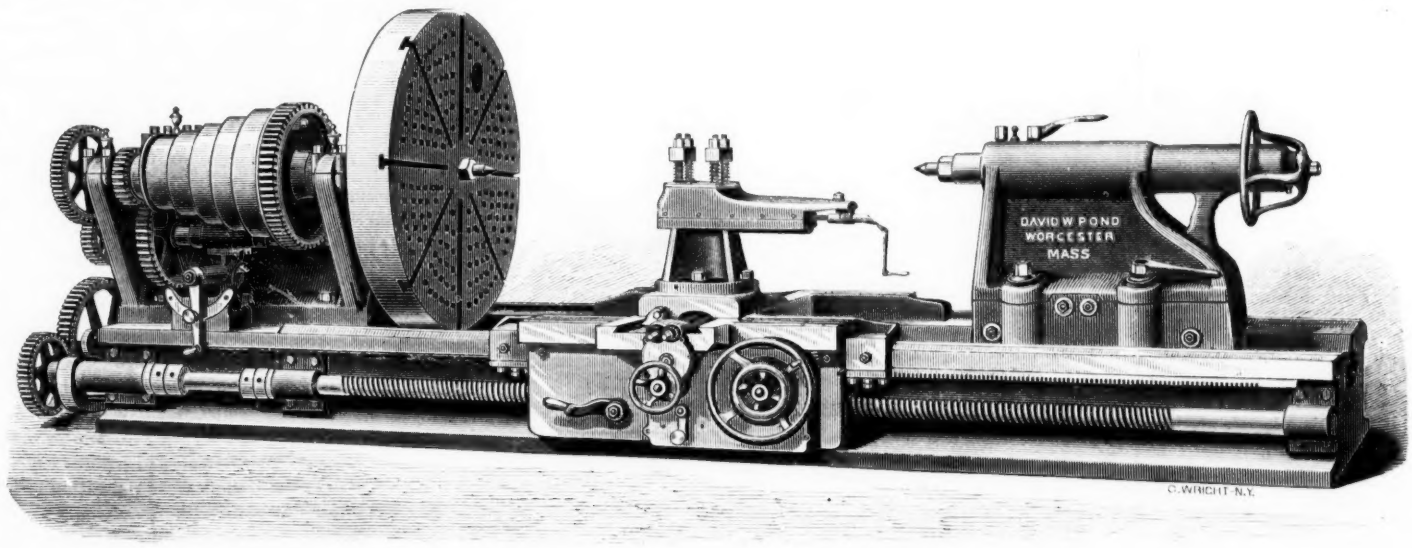
New Engine Lathe.—60 Inch Swing.

Upon this page is shown an engraving of a new engine lathe of extraordinary capacity. It is very heavy, but the design is such that it can be operated as conveniently and quickly as smaller lathes, the feeding device being the same, with the exception that gears and other parts are made strong enough for the largest work that can be done on the lathe, and that provision is made for power feed at any angle.

The feed motion is positive and very simple, and the tool can be made to travel forward and backward the length of the bed, or across the rest by a single movement of handles on the rest. This makes it always within reach of the workmen when watching the cut.

The cross feed has sufficient traverse to "square off" the entire swing of the lathe with setting the tool but once.



NEW ENGINE LATHE.—SIXTY INCH SWING.

The feed gearing is connected to the rack on the bed, and is driven from a slot in the screw arranged not to use the thread; consequently its accuracy is not impaired for screw cutting, and is without worm or screw.

The rack pinion is so arranged that it can be drawn entirely out of the rack, absolutely preventing the friction feed from becoming engaged while cutting screws and thereby causing breakage; also, avoids wear of gearing and shafts in apron when screw cutting.

The feed motion is applied by a simple and positive friction. No studs are used. Every wheel or gear is mounted on a shaft having a bearing at each end, all small gears and shafts being made of wrought iron or steel, and all parts subject to bruising wear being case hardened.

The range of threads that can be cut is from 16 threads to one inch, to 1 thread in six inches.

All moving parts have unusually long bearings. This includes the rest or carriage on the bed, also the tail block, the cross shoe on rest, the tool shoe on swivel, the top of tail block on its base in setting to turn tapers, the length of tail spindle, and head spindle and its journals. The diameters of the cone, gears, journal bearings and tail spindle are unusually large.

The rest is gibbed to the outside of the bed, both front and back, by a new device that permits adjustment without use of springs or additional pieces, and by the turning of two bolts it can be locked to the bed to prevent backing off when facing work. The head is arranged with a five section cone, having gears calculated to give fifteen changes of speed, the slowest being correct for the full swing of the lathe, and the fastest for as small as three inches diameter, the change between any two speeds being the same. This cone is mounted on a shaft with pinion on same playing into an internal gear on the face plate. To connect different gears to produce desired speed, a device easily worked by hand lever is used.

The tail block is secured by four large bolts, and can be set over for taper by means of one screw at front of lathe and locked in position in addition to holding bolts. It has two shafts, one at the back and the other at front end of lower side; these are so arranged that the whole can be lifted off the bed, bringing the weight upon four rolls, thus making it possible to move so great a weight conveniently.

This large lathe is one of the latest new machine tools brought out by David W. Pond, Worcester, Mass.

Some shop owners wonder why they don't get as much work out of the same number of men as other establishments having equal facilities. The reason is, they employ too cheap a grade of foremen, thus wasting time and money.

Construction and Operation of Steam Traps.

BY WILLIAM J. BALDWIN.

The term "trap" has two distinct meanings to the steam-fitter; one implies a condition only, the other, an appliance.

As the *condition* has nothing to do with the present article, I will dispose of it by saying: It is the sagging of a pipe, either by accident or design, so that it fills with water and interferes with the free circulation or passage of the steam.

The *appliances*, being the subject under consideration, and forming a separate and distinct part of almost all heating apparatus, except the gravity system—I will attempt to explain. They may properly be divided into three distinct classes, and the construction and operation of one or more of each kind, will be described.

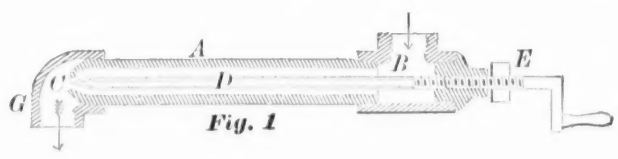


Fig. 1

The expansion-trap being the oldest, I will consider it first. It embraces two kinds, one composed of two metals of different co-efficients of expansion, the other depending on the expansion of a liquid, as alcohol or mercury enclosed within a metal case.

Fig. 1 is a section of a simple form of expansion-trap to show the action of two metals, iron and brass being mostly in use, and the expansion of the brass being a little over one-half more than that of iron, for the same rise in temperature. *A*, is a piece of iron gas pipe, closed at one end, with a hole *C*, drilled through it. On the other end is a common T, with a plug screwed into it, as shown. *D* is a brass rod, with a taper point on one end, made to form a valve with the hole *C*, with a long screw on the other end to fit through a threaded hole in the plug. *F* is a jam-nut to fasten the rod when adjusted. The side of the T (*B*) is the inlet, and the elbow, *G* the outlet. To adjust the the trap, the brass rod is advanced into the hole *C*, until the live steam is shut off.

The operation is in this wise:—when the condensed water fills the pipe *A*, it cools both the pipe and brass rod, but as the brass rod contracts more than the iron pipe for the same difference in temperature, the brass rod draws back from the hole *C*, and allows the water to pass. As soon as the temperature increases again, by the admission of steam, the rod and the pipe expand, but as the rod expands more than the pipe, the hole is closed, and the pipe is again ready to receive water and hold back steam.

Fig. 2 shows a section of one of the expanding liquid traps. In general appearance it is like an angle valve, but much larger. *A*, is the valve body; *B*, a hollow disk, with an expanding bottom, like an oil can, filled with any liquid that will not freeze, and that has a greater coefficient of expansion than the metal which encloses it. *C*, is a valve seat. The following is the operation of this trap: When the live steam is blowing through, the disk is closed down, the same as in a valve, until the steam has just stopped; the heat of the steam, in the meantime, having expanded the liquid, and swelled the sides and bottom of the hollow disk, thus allowing it to contract away from the valve seat when the temperature falls, by having the condensed water collect around it, which water in turn passes off, and is followed by steam, which again swells it, thus closing it.

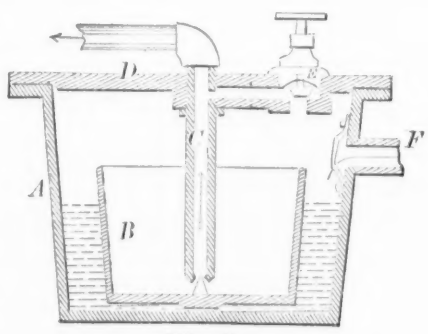


Fig. 3

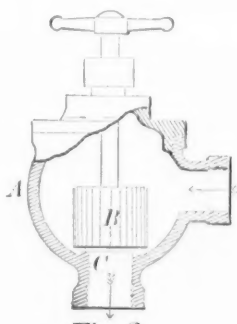


Fig. 2

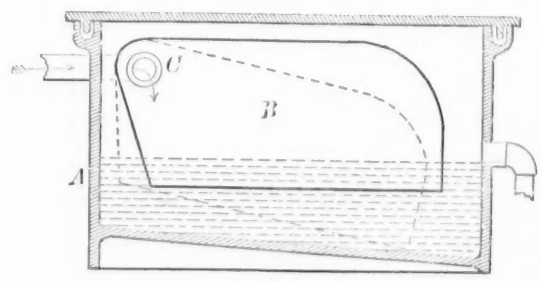


Fig. 4

The "pot trap" belongs to the second class, and is much used by those who understand it.

Fig. 3 shows section of the common form of this trap, embracing all the necessary points of construction. *A*, is a cast-iron pot, sufficiently strong to withstand high pressure steam, with an inlet at *F*; *B*, is another pot (an open pot), inside the pot *A*, with a spike at the center of the bottom,

and a guide to keep the inner pot in a central position. *C*, is a brass tube screwed into the cover *D*, and forming a valve with the spike at the inside of the bottom of the pot *B; E*, a valve in the cover of pot *A*, which, when opened, acts as an air valve, or *blow-through*, to hurry up the circulation when first heating up the coils.

The pot trap operates thus: The condensed water from the coils, etc., runs in at the pipe *F*, and fills the outer pot *A*, with water, until it floats the inner pot *B*, against the stem *C*, closing the valve formed by the spike and the tube, thus closing the outlet to the tank or sewer. The water, which still continues to flow into the outside pot, rises, and overflows into the inside pot. Then the latter sinks, and opens the valve which the spike forms with the hollow stem, allowing all the water in the inner pot to be forced up through the stem and out, by the pressure of the steam in the upper part of the pot, acting on the surface of the water. Thus, when the inner pot becomes buoyant again, by the discharge of its water, it closes the valve, and leaves it so, until the increase of the condensed water again overflows it. This action is intermittent, the frequency of it depending on the amount of work to be done.

There is one point in the construction of of this trap, on which depends its working, namely: The area in square inches of the hole in the end of the hollow stem *C*, must be no larger than the quotient obtained by dividing the weight in pounds of the inner pot, when submerged, by the maximum pressure, in pounds per square inch, of the steam to be carried.

Thus, if the inner pot weighs 12½ pounds under water, and the greater pressure of steam is to be 100 pounds per square inch, the hole must be a little smaller than ⅛ the area of a square inch, say a round hole ¼ of an inch in diameter, which leaves a factor of safety of ⅛ the weight of the pot. The reason for this is plain, when we consider that there is practically no pressure within the stem when the valve is closed; and for the pot to sink, when it is full, it must be heavy enough to pull itself away from the stem, and still be light enough to float ¼ of its height, when empty.

This trap possesses a special point of excellence. It will discharge the water of condensation from coils, or from the cylinder of an engine, into a tank or sewer at a very much higher level than that which it drains; and it will keep them as dry as if it discharged downward. It is the only trap, opening to atmosphere, which will do this.

There are one or two modifications of this trap, but they differ only in the arrangement, being convenient to clean, etc. There is another *open float trap*, Fig. 4, which contains a special point of merit, the valve of which is not generally understood, namely, the trap is capable of taking recognition, so to speak, of temperature, as well as quantity; and will discharge its water down to atmospheric temperature and pressure, no matter what may be the temperature of the water in the coils, due to high pressure.

To make this clear, it is necessary to explain that water which falls to the bottom side of a nearly horizontal pipe, with 50 pounds pressure of steam in it, has not fallen to a temperature of 212° Fahrenheit, as is very generally supposed, but has simply parted with the latent heat of the steam incidental to the pressure, leaving the temperature of the water (when the flow and pressure of the steam are maintained) a very little less than the temperature of the steam. This water will again give off some of its sensible heat, to be again made latent, to make steam of a lower pressure, when allowed to expand. But it must not be understood that all the water flies into steam. It does not—the quantity of water converted into steam being represented by the ratio the latent heat of the steam at the different pressures bears to the sum of the latent heat and the sensible heat of steam.

Thus, when water is drawn directly from a high pressure coil into the receiver of a trap, and is discharged against atmosphere, before the water has cooled below 212°, it is attended with considerable loss of heat. This can be seen in the blowing of a gauge cock, for, though the water is solid and dense in the boiler, when it is drawn, some of it flies into steam, and makes a cloud which often deludes the novice into the belief that it is all steam, and that possibly he has low water.

A is the outside case with a loose cover; *B* the invested open float; *C* the common plug cock, operated by the float.

The operation is as follows: When steam or hot water which is capable of giving off steam, is discharged through the cock *C* under the float *B* (which we will suppose to be down), the expansion of the steam immediately raises it, and closes the cock, until the steam under the float condenses, when it sinks to admit just enough hot water to create steam enough to lift it again, and close the cock, and thus the action goes on.

When the temperature of the water in the pipes near the trap is below 212°, it flows out rapidly, and, passing under the edge of the float), which will be down in the position shown by the dotted lines), goes through the outlet, but, should the temperature of the water be 225° or 250°, or any other temperature incidental to the pressure of steam within the pipe to be drained, the escaping

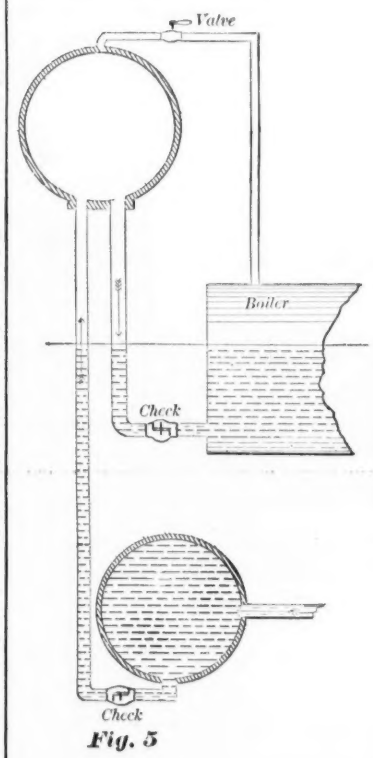


Fig. 5

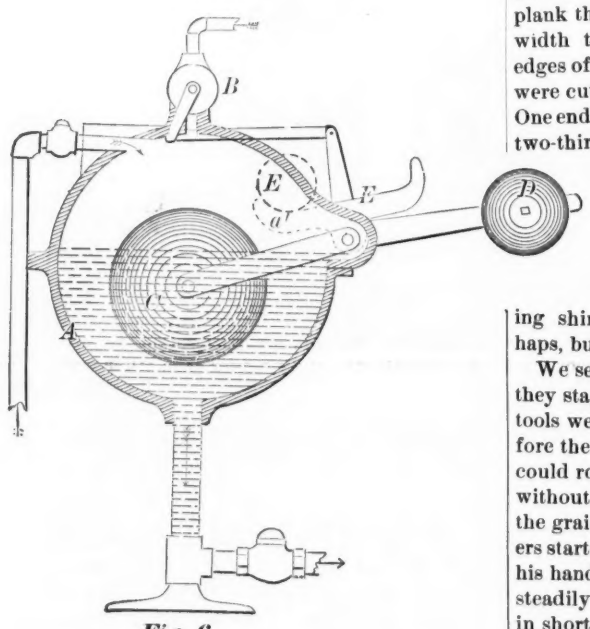


Fig. 6

water, as it passes the cock *C*, will give off steam enough to raise the float, and prevent the efflux of the water, until it reaches 212°, or lower. Of course, this water may be held in the pipes, or coils, but not at a lower temperature than 212°.

When water at 212°, or lower, is received into an open tank, *i. e.*, a tank without pressure, with an opening to the atmosphere, there will be little or no loss of heat, as the water can be pumped back into the boiler by having the pump cylinder so low that the water may gravitate from the tank into it. But when water passes a trap, say at 250°, and expands into an open tank, the loss, which cannot be recovered, is directly as the difference between 250 and 212 is to 966.

A class of traps which has come into use within the last ten years, and which formed a new departure in steam engineering, is the *automatic-direct-return-steam-trap*. There are at least three very good modifications of this trap now before the public, accomplishing all that can be done by a steam pump in the way of returning the water to the boiler.

Of this trap, the points of excellence are: It will return the water from a coil below the water line of the boiler, and keep the coil as dry as any other part of the circulation; it loses no heat by the expansion of the steam contained in hot water; there is no loss of heat from it, except that which is due to the radiation from its surface, and that can be utilized in the warming of the building, and, unlike a pump, it has no loss of heat from an exhaust. It can be put on a direct-return gravity circulation that has been botched to a certain extent only, and will make it work; and it can be used as a boiler feeder, using the minimum of energy, which is manifest only in radiation from its outside. The latter should not be covered with non-conducting material, with a view to save heat, for on its cooling surface depends its power.

The principle involved in this class of traps is simple indeed, and I will try to explain it with the use of the diagram, Fig. 5.

It is generally known to users of steam and others, that, if a tight hollow globe, or tank, is filled with steam so as to expel the air, and the steam allowed to condense (which it will do in a short time, by the transmission of its heat to the surrounding atmosphere), there will be a partial vacuum formed in the globe or tank. Now, if there is a pipe from this globe connected with the bottom of another globe containing water, the water will rise into the upper one, when there is a pressure in the pipe, which comes to the lower one from any source of supply (the condensed water from the heating apparatus, for instance), and this pressure need not be above that of the atmosphere. Now, if a steam pipe from a boiler, with a valve in it, connects with the upper part of the upper globe, and a pipe from the lower part of the upper globe connects with the boiler below the water line, the water in the upper globe will level into the boiler when the valve in the pipe is opened, the pressure in the globe becoming practically the same as in the boiler. Again, close the valve in the steam-pipe, and when the steam already in the upper globe condenses, the water from the lower one will again rise into the upper one. There should be a check-valve in the pipe leading from the under side of the upper globe to below the water line in the boiler to prevent any water from returning by that pipe. The water which has thus risen will again be leveled down to the water line of the boiler upon the opening of the steam valve.

This principle was understood and used, substantially as explained, before the automatic traps were introduced, but, as it was necessary for the engineer to attend to the opening and closing of the valve, makers did not use them. Thus, the only difficulty to be overcome in this class of traps is to have an automatic contrivance for opening and closing the steam-valve which can be relied upon.

Fig. 6 shows section of one of these traps, *A*, being the globe; *B*, the automatically moved steam valve; *C*, a strong cast-iron float, with a counter-poise *D*, to get the requlred balance; and *E*, an auxiliary, which consists of a ball *E'* and a track *a'* which are connected in such a manner with the float spindle, that when the float rises by the increase of water in the globe, the track, *a'*, passes the horizontal position, the ball, *E'*, runs to the opposite end, and the force of the blow on the hook at the end of the track pulls the valve open and admits the steam. The latter presses the water into the boiler, and leaving the globe empty, the float sinks, allowing the ball to run back, and close the valve by striking the other hook. This auxiliary is necessary for the same reason that a direct-acting reciprocating pump, without a fly-wheel, requires help at the end of its stroke.

Letters from Practical Men.

MACHINE SHOP FLOORS.

Editor American Machinist:

In the AMERICAN MACHINIST, dated August 28, Chordal touches the subject of machine floors, and invites any one who can show up a decent floor to unfold himself.

Some years ago, in starting a machine shop, and fitting a building therefor, I had about the same reflections concerning the floor that Chordal has so graphically described, and resolved on a change, knowing that I could not by any chance construct a worse floor to sustain tools, or to work upon, than some I had seen. Loads of dirt and gravel were wheeled in and water run on freely to settle it until the filling was six inches lower than the top of the floor required, when the filling was carefully leveled with coarse sand, and rolled with a heavy stone roller. On this filling was laid a floor of boards, both sides of which had been covered with boiling coal tar and pitch. Blocks of wood had been prepared by sawing plank three-and-a half inches thick, and any width the logs would cut, and leave the edges of the planks square. These planks were cut up into sections five inches long. One end of each block was dipped half or two-thirds its length in the hot tar and set on the board flooring, the tarred end down. In putting down the blocks, they were made to cover or lap over the joints between blocks previously laid, like builders "breaking joints" when laying shingles. This was unnecessary, perhaps, but it was done.

We set the smaller tools on the floor, and they stayed where they were placed; heavier tools were placed on stone piers, put in before the floor was laid. The result was, we could roll a heavy wheel across the shop without fear of breaking through, and as the grain of the wood was vertical, no slivers started up to throw a man down, or tear his hands in picking up anything, no knots steadily rising from the surface around them; in short, it was quite satisfactory.

I do not know whether the plan was new or not; I never saw another floor of the kind, but have seen many I thought would be much better if they were put in substantially in the same way. Let me say, however, in the case described, the blocks were but slightly seasoned, as dry logs could not be found to make them of, and there was no time to give the blocks a chance to dry out. While the blocks were shrinking, the iron chips and dirt, in sweeping, filled the cracks so there was no trouble, but if I had a similar job to do, and time to do it, I would, of course, make the floor of dry stuff.

Yours,
A. W. Fox.

Baldwinsville, N. Y.

POLISHING IN A LATHE.

Editor American Machinist:

I submit my plan for polishing in a lathe, which I have often used when I wanted to make an extra polish. After turning and making ready for the finish, take a piece of tool steel, say ⅛″ thick, 1½″ wide, and draw the end until it is very thin. Sharpen it, and rub on an oil stone until a very fine edge is made, and then scrape the work until no scratches are visible. Such a tool, in the hand of a man of practice, can finish work finer and quicker. Use no emery; but take a soft pine stick and oil. Be careful that there is no grit or dirt in the stick.

I will relate a circumstance that happened in a shop some 20 years ago. In preparing to show an engine in an Exposition, the cylinder heads were given to different mechanics, and they all used emery, files, and

emery paper, but the work would not suit our foreman. Finally, it was given to me. I turned all the polish off, and then went to work with my scraper, and finished the cylinder heads as described. It was then inspected by everybody in the shop, who declared that not a scratch was to be seen, and that the polish had a bright and lively appearance, not dull, as when finished with emery. The skillful use of the scraper requires practice, and I had used it only when I wanted polish, hence I had considerable practice and knew what could be done. I was, at that time, a stranger in the shop.

Perhaps, however, I can do the work better than I can write about it.

Yours respectfully,
FRANK THOMAS.

Cincinnati, O.

Editor American Machinist:

Some weeks ago, a succession of incidents made such an impression on my mind, that I was forced to cry out; the result of the crying was "Mechanical Confusion" in AMERICAN MACHINIST of May 20th.

Since that time the confusion has given evidence that it still lives, as is attested by Mr. Durkie's communication of July 17th.

How he can construe my remarks as opposed to the evident laws of friction, I cannot understand. I said nothing in particular in regard to thickness of belts, leaving therefore the inference that in comparing widths, the same thickness is to be preserved in such cases. It must be confessed that thickness does add weight and strength to a belt, and after Mr. D. has decided on the thickness and also on the width of the belt he wishes to employ, I will put on another of the same dimensions, by the side of the first, and thus drive double the load; thereby establishing the position I have taken, viz.: "the resistance of a belt to slipping is *not* independent of its width." If the second belt should be placed *on top* of the first one, we should fall considerably short of driving a "double load," leading us to suppose that the action of belting is controlled by conditions, varying somewhat from those governing the production of friction.

To illustrate the effect of different widths, suppose two different machines, driven from opposite ends of a line shaft, each requiring 10 H.P. Now if the two belts were just sufficient for the work, and we take the belt off one machine, and by bringing the machines into a position in which they could be connected to each other, it must be evident that the remaining driving belt would be insufficient for the operation of both machines; but by now doubling the width of the driving belt and pulleys, we would restore the conditions first set forth.

The action of round belts and rail road tracks, although depending on resistance to slipping for their utility, are controlled by some conditions that do not enter into the operation of flat belts.

For further comments I would refer the gentleman to remarks by Mr. Rose, in the same number of the AMERICAN MACHINIST that contains his communication, and here I would say a word in relation to Mr. R's gentle hit at "cast iron rules." There are many rules and formulæ, that do not work out the equation unless the proper conditions are observed; and there seems to be a tendency in human minds to go blindly according to the rules under all conditions, in spite of the evidence of every day practice.

If we do not include all the factors, the result will not be what we look for. The facts don't care whether we overlook them or not; if they are not consulted, they give no evidence; hence, confusion, simply because we think we have put forth the efforts necessary to accomplish certain results, and not reaching the conclusions looked for, doubt ensues.

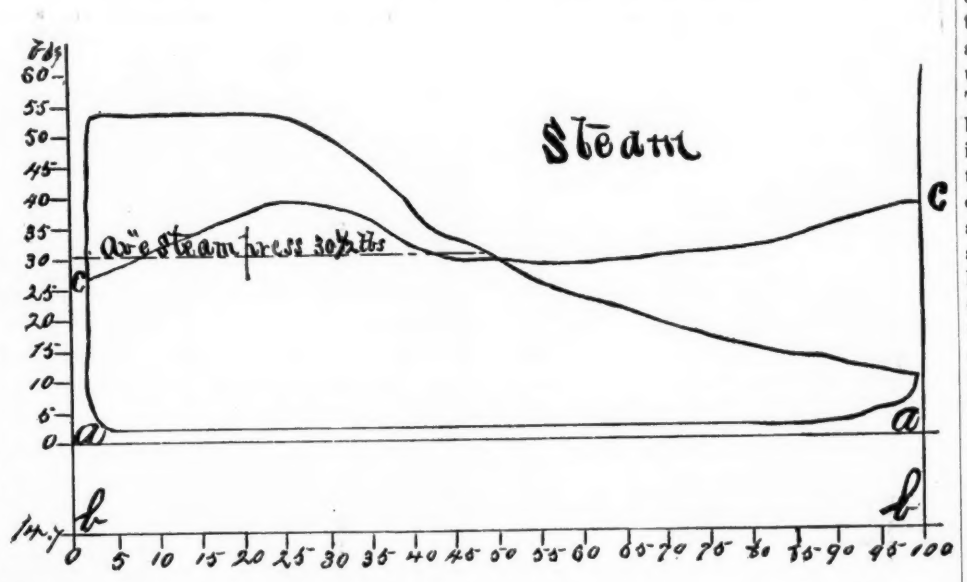
Mr. Rose gives some one a chance to explain the difference between area of contact obtained by increase of arc, and that obtained by increase of width. The relation between dollars and power, favors the "wide idea." Now I suppose that last remark will be construed by some folks, so as to conflict with the idea of "high speed belting;" but if they will only find out what they are going to think about, before they begin to think, they will come out all right.

I would now refer to Mr. Cooper's remarks, as cited by Mr. R., to the effect that the pressure of the atmosphere becomes sensible, only when resisted by action perpendicular to the surfaces in contact. Mr. C. apparently ignores the friction that would be produced by bodies sliding over each other, with their surfaces held in contact by pressure.

If I understand him, he may as well say that the weight of a body only becomes sensible, when an attempt is made to lift it. It must be granted, that the pressure of a body, or of the atmosphere, will only be realized when an attempt is made to move it in a direction opposed by its weight; but, the friction of a body is the resistance offered to moving the body over a surface, in a direction not opposed by its weight. Hence, in considering the action of atmospheric pressure on belting in contact with pulleys, we do not look for any driving force, resulting directly from such pressure, but from the resistance to slipping, due to the force with which the belt is held to the pulley by said pressure, precisely as any other body offers resistance to being slid over a surface.

Yours truly
CHAS. A. HAGUE.

Chicago, Ill.



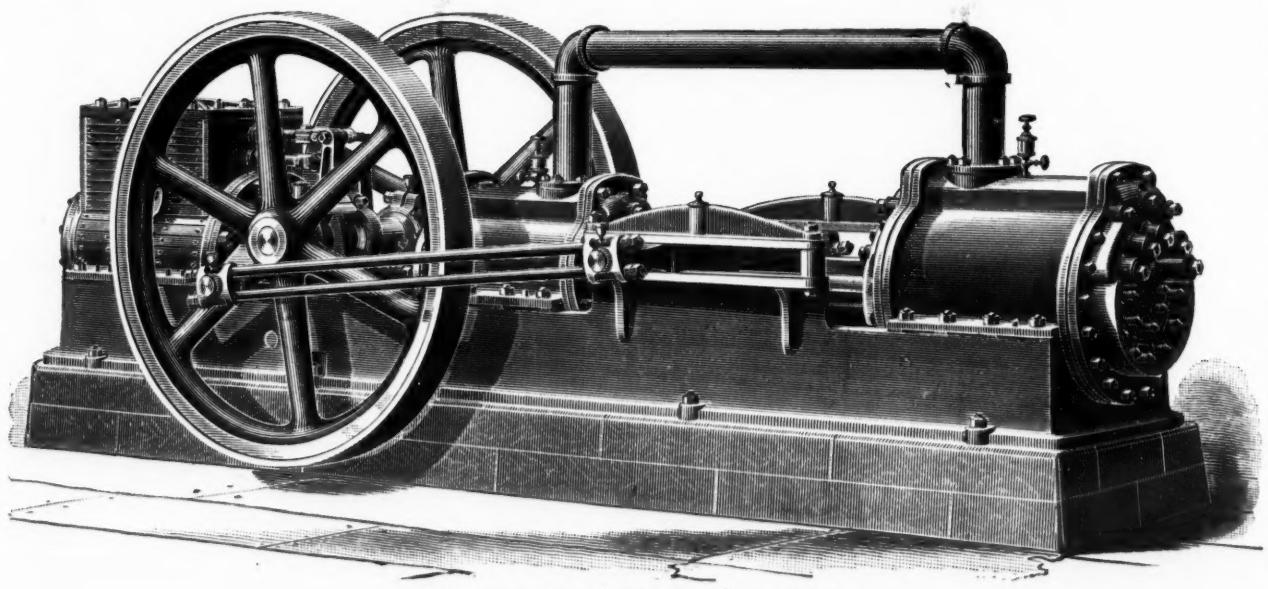
Compound High Speed Air Compressor.

The accompanying illustration represents an improved style of air compressor, the main features of which were described, with an engraving of a compressor, made by the same establishment, in our issue of April 3, 1880. There are, however, some new and valuable advantages connected with this compressor that deserve special attention. The steam cylinder is 20×24 inches, the receiving air cylinder, 20×24 inches, and compressing cylinder 13½×24 inches. It is well understood that the physical changes which take place in the air cylinder of an air compressor, are precisely the reverse of the changes which occur in the steam cylinder of a steam engine, using steam expansively. In the steam engine the greatest pressure is at the beginning of the stroke while it diminishes to zero at the end; while in the air compressor the resistance is nothing at the beginning, and the greatest at the end of the stroke.

In the steam engine the steam is cooled by expansion and condenses, while in the air compressor the air becomes very hot by compression. The first and greatest problem to be solved in constructing an air compressor is to adapt the steam engine having its greatest power at the first part of its stroke to drive an air piston which has its greatest resistance at the last part of the stroke. To equalize these differences in some measure, heavy fly wheels, counterpoise weights, and other devices have been employed by some manufacturers with different degrees of success. The builders of the compressor shown in the engraving, claim to accomplish excellent results by employing a large cylinder in which to create the initial air pressure, while small cylinders are used in which to make the heavy final compression. In this machine two or more double acting cylinders of diminished diameters are placed in line, the air being compressed from one into the other, and thus brought to the required pressure. By this arrangement much of the resistance to be overcome is claimed to be transferred from the end to the beginning of the stroke, and a more uniform pressure for the whole stroke obtained.

Having succeeded in obtaining a nearly uniform pressure throughout the stroke, it is also desirable to render the application of power uniform for the whole stroke, without complicated mechanism, which is claimed to be accomplished by mounting the steam and air piston, and their crossheads, upon the same piston rod. These parts are purposely given weight enough so that it requires most of the power of the steam over and above the air resistance at the beginning of the stroke to start them forward at the required speed. At the end of the stroke, when the steam has lost its power by expansion, the energy contained in the momentum of these reciprocating parts is given out in the accomplishment of work, and the parts are brought to rest by expending their force upon the air in the compressing cylinders. The speed of running, at which the full benefit of the reciprocating parts is obtained, is calculated also to be the speed at which the steam is found to be the most economical. It is claimed that the uniform resistance and power, both applied as end thrust and pull upon a straight steel piston rod, leave little work for fly wheels to perform. They cannot be dispensed with, however, for obvious reasons. The head, generated by compression, is disposed of by the air coming in contact with the cooling surfaces of two water jackets, as, during compression, it is forced from one cylinder to the other. The air is also much longer undergoing compression, as well as being longer in contact with the cooling surfaces, thus giving the bed of compression time to escape.

These advantages admit of a higher speed than could otherwise be attained. The work is distributed between the two cylinders. Thus the larger one is kept cool and the indication air is not rarified by taking up heat from its surfaces. The air is also allowed to cool in the intermediate pipe between the two cylinders. In some cases a reservoir is used to better accomplish this purpose.



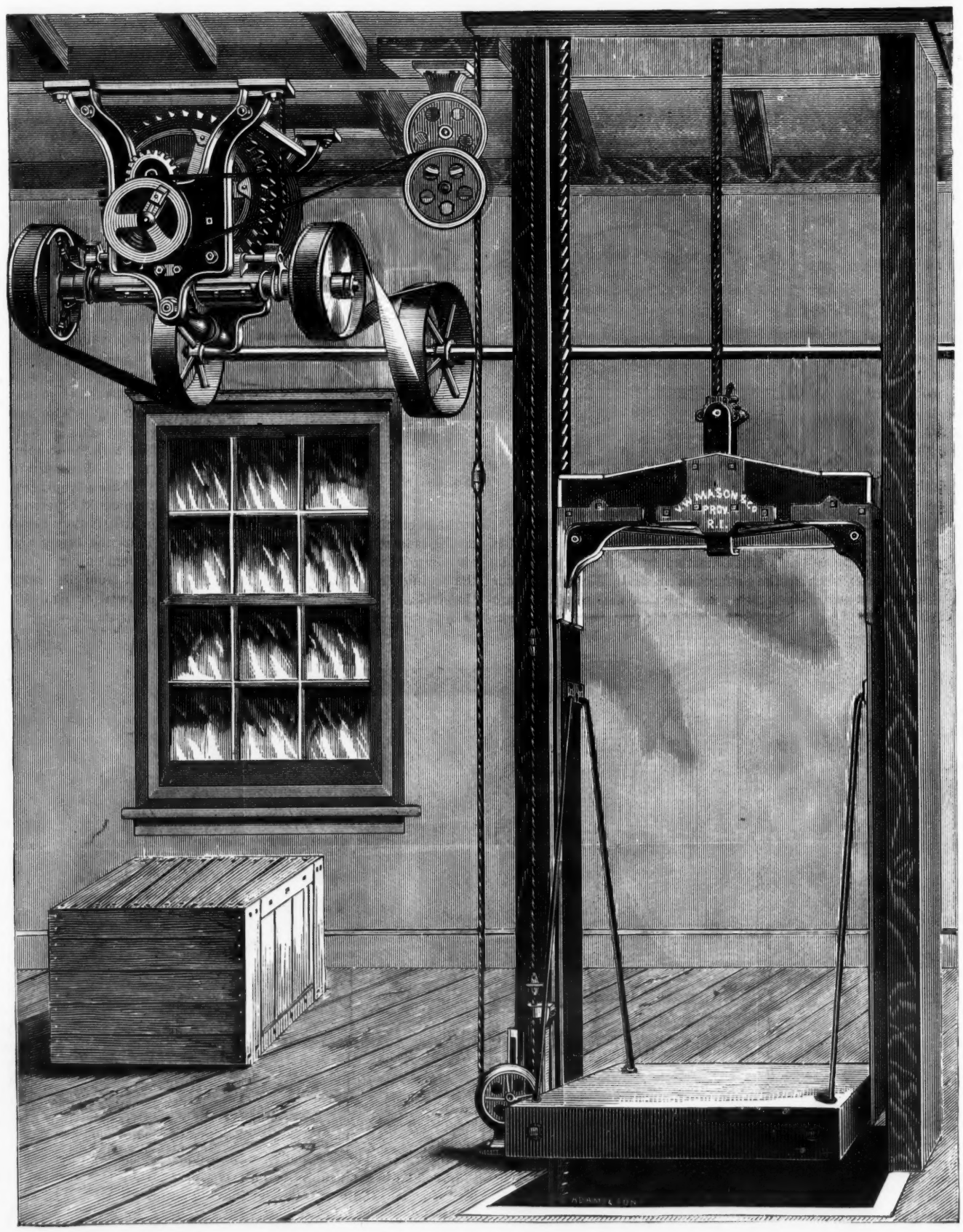
COMPOUND HIGH SPEED AIR COMPRESSOR.

On account of the small clearance given to the pistons and the small diameter of the cylinder, the air not discharged at each stroke is very little, and are claimed to be much less than with some single cylinder compressors. The product of the compound compressor is dry air. The card shown herewith was taken from one of these compressors while performing ordinary duty. This card shows the extent of expansion, also the influence of the reciprocating parts represented by the line *C C*, showing that the application of power is nearly uniform, although the cut-off takes place early in the stroke. The steam was used and the pipes not jacketed when this card was taken. Steam cylinder is 20 inches by 24 inches; receiving air cylinder, 20 inches by 24 inches; compressing cylinder, 13½ inches by 24 inches; revolutions per minute, 95; piston speed, 380 feet; air pressure in receiver, 55 pounds. The figures at the bottom indicate the per cent. of stroke. It is claimed that a steam pressure of 30 pounds in these compressors will produce an air pressure of 50 pounds, but with steam of higher pressures and running at high speed it is claimed that the air pressure may be delivered at double that of the steam.

These compressors are provided with steam expansion valves, adjustable to suit the requirements of different pressures of steam and air. They are manufactured by the Norwalk Iron Works Company, South Norwalk, Conn.

Hoisting Machine for Elevators.

The engraving on this page represents an elevator hoisting machine, manufactured by Volney W. Mason & Co., Providence, R. I. The machinery for operating this elevator is compactly arranged on a single iron frame for bolting up overhead, so that the complete outfit takes up only the floor room necessary for the well; and the shafting is not liable to get out of line. A peculiarity of the hoisting machinery is, that no belt-shifter is used, the starting and stopping being performed by a new friction pulley, only requiring half the space of the ordinary tight and loose pulleys. By this arrangement, considerable wear of belts is saved, besides being more quickly worked. The clutches are operated by toggle joint levers, which are known to be a powerful means of producing a strong wedge-like motion. The attendant can stop the elevator gradually or suddenly, or the motion may be instantaneously reversed, thus insuring great safety and reliability.



HOISTING MACHINE FOR ELEVATORS.

The New York *Express* says: "A number of boat owners and their employes, doing business along the canals of this State, and making this city their headquarters, have determined to join the men at Buffalo and Troy in opposing the Belgian steam-towing canal system. The men claim that their business will be entirely wiped out in the course of a few years, as horse or the old system of canal-towing will have to give way to steam-motors. In order to test the validity of the charter granted by the Legislature to the Belgian Steam-Towing Company, or to compel this company to pay for the injury done to their canal trade, the boat owners have put the whole matter in the hands of three prominent State lawyers, for the purpose of ascertaining whether the charter can be upset or damages assessed. Should they advise that such can be done, the matter will be placed in their hands, and, if possible, an injunction obtained against the construction of any further portion of the Belgian cable system."

The new Holly Pumping Engines at the Troy, N. Y., Water Works have been tested. The contract called for a duty of 80 million foot pounds per hundred pounds of coal, and the test showed a capacity of 85 million foot pounds. They were to pump 6 million gallons a day and showed by the test a capacity of 7 million gallons a day.

The Machinist's Trade and Industrial Education.

BY PROF. S. W. ROBINSON, DEP'T OF MECH. ENG., OHIO STATE UNIVERSITY.

An article lately appearing in the AMERICAN MACHINIST on the latter of these subjects would make it appear that there are far too few schools of industrial education in this country. As to the introduction of this instruction into the lower schools, it is too true; but in the higher educational institutions, this instruction has been provided for, to such an extent that there is at present ample room for more young men to receive such advantages. The Congressional Land Grant of 1862, providing for this education, has been quite successful as a means, and its wisdom is evinced in the fact that the very education it contemplated, though scarcely in demand in '62, is now seen to be exactly adapted to the needs of the country. The old-fashioned classical course is an excellent one for culture, but for a man to take that and a practical course, separately and in succession, was, ten or fifteen years ago, discovered to be too slow for the steam and lightning speed of to-day. This fact, and the land grant scheme, have happily resulted in the very thing needed, viz.: schools all over the land where practical and theoretical training can be obtained simultaneously, thus accomplishing the feat of reducing the time, from eight years to four, in which a young man may train his hand and head for precisely what he wants to follow.

An article on the first-named topic puts it right, when it says that opportunities for learning the machinist's trade are now poor, because of the changed systems of doing mechanical work. Not only is this true, but the demand for the old-fashioned "pan-handed" (that is, a hand for every kind of machine work) machinist has also changed for that very reason. Machinery is now manufactured instead of "made" or "built" as those words were formerly understood. Hence the so called machinist of to-day can plane, or turn, or file, or fit, only one thing, instead of having a hand for everything.

There is now less demand for versatility in the practical machinist, and on account of this self-same concentration of machine work in large factories, the demand for a few men as foremen and superintendents capable, on account of practical and professional training, of successfully bearing the enlarged responsibilities of large factories, is also much enlarged, not so much for numbers perhaps, as for qualification. These it becomes the peculiar and fitting office of the schools of industrial education to provide.

A number of these schools, which have come under the personal knowledge and observation of the writer, are successfully doing this. These men thus sent out are variously engaged, but among them are included all kinds of work connected with the production of machinery. And most of them began their mechanical training at the schools, that is, had never served apprenticeships previously. Indeed, so far have some of these schools succeeded in what might be naturally considered the unsuccessful part, viz., the practical, that some of these men commenced with a foothold as journeymen, though rapidly advancing to more responsible positions.

Although tremendous changes and advances have been made in the mechanical world within the last twenty years, they are not altogether one-sided. Indeed, it is high time that those who have been seven-eighths or nine-tenths asleep most of this time, should rise up, dig out their eyes and dust themselves, so that they can, in some degree, take in the situation, and recognize the grand system which, as though by an unseen hand of wisdom, has been sent in upon us; a system which gives us very superior articles, of rapidly increasing variety, in rich abundance, and at figures which are within the reach of the most humble.

Some enterprising scamps have started a new business—that of issuing forged railway tickets.

It is reported that the foundation for a new cotton mill, of 75,000 spindles, is to be put in at Waterville, Me., this fall.

A grape sugar, or glucose, factory recently began operations at Hamilton, O.

The census statistics of Cincinnati's manufactures showed that she turned out about $200,000,000 worth of material last year.

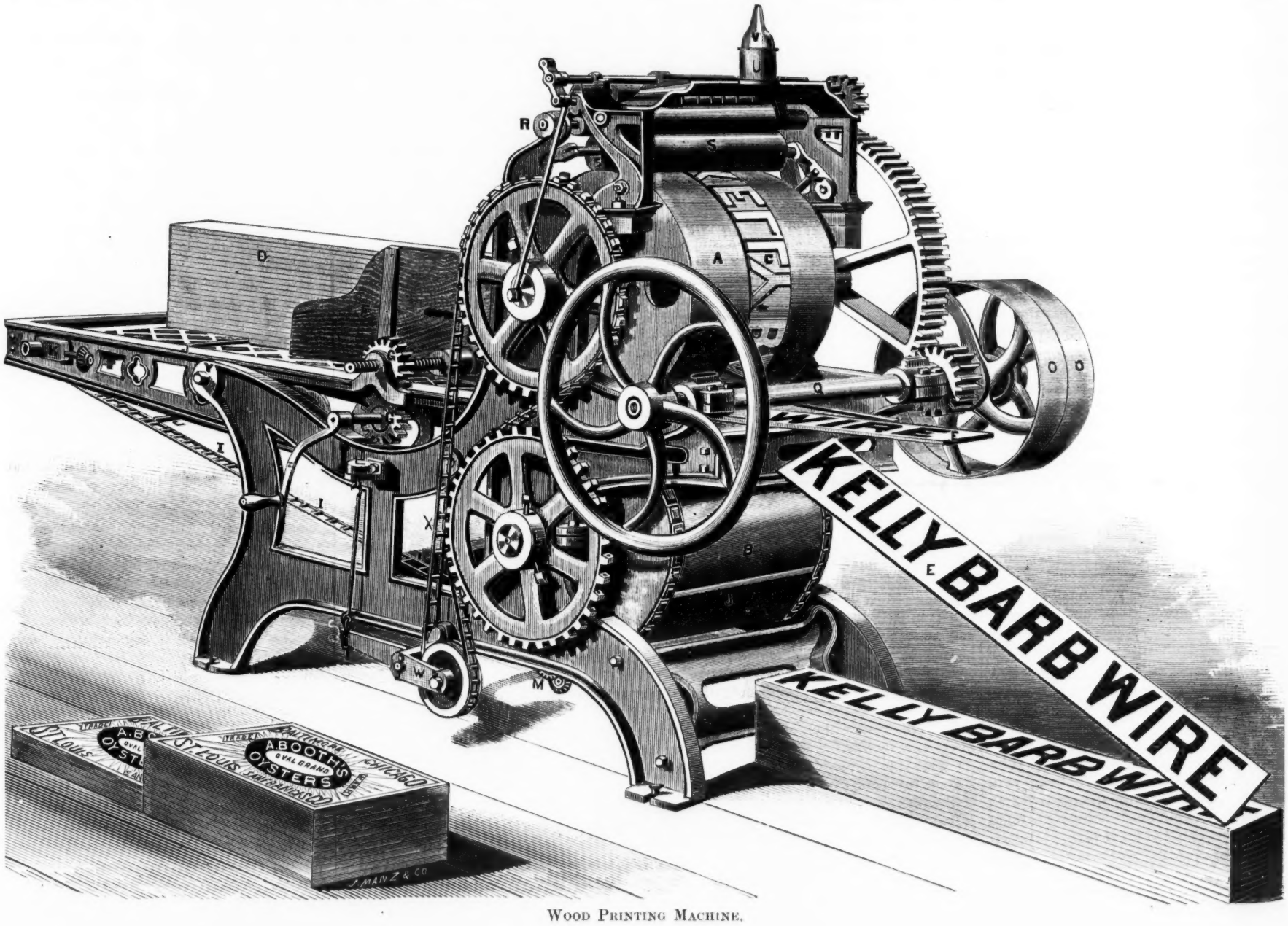
$500,000 has been subscribed for a glucose factory at Ithaca, N. Y.

Wood Printing Machine.

We illustrate on this page a novel machine designed to produce cheap board signs, and durable labels for wooden boxes and casks. In general appearance it resembles an ordinary printing press, to which, in fact, it is very similar; the principal difference being that the types are placed on the revolving cylinder, instead of on the moving bed underneath, which, in this machine, carries the matter to be printed.

At *D* will be seen a pile of lumber, from the under side of which the endless chain feed *I* takes the boards, one by one, under the dies for impression. There is provided a small degree of flexible movement for the bed to accommodate irregularities of the lumber, after it is once set. The setting for different thicknesses is performed by a wheel *M*, connected by an endless chain with screw columns.

The handle *H*, actuates, by means of gear wheels, right and left-handed screws connected to the lumber holder for adjusting to different widths from 1 to 18 inches. The ink rolls are at the top, and are supplied with ink from the holder *U*, into which is fitted a piston *V*, of the right weight to produce the required feed. The type or dies are made of rolled brass, and are very hard. This machine and a similar one for smaller work, are manufactured by Cross & Co., 59 Clark St., Chicago, Ill.



WOOD PRINTING MACHINE.

English Co-operative Societies.

The capital of the original co-operative society in England, founded in 1844 with 25 members, is now $2,440,175; its membership, 10,429, and the profits for the last quarter, $66,385; in the last report to the government, which bears date 1878, 1289 societies in England, Scotland and Wales are mentioned. The aggregate membership of these is 554,773; the sales during the year amounted to the magnificent sum of $104,865,795, and the net profits, after paying trade expenses and interest on loans and capital to the amount of $7,361,355, amount to $9,002,340. This result was accomplished on a share capital of $18,292,350, and loans to the amount of $4,288,835. In England all the money remaining after paying 5 per cent. on the capital, which is provided by the customers, and the working expenses of the store, is divided among the customers in proportion to their purchases.

A little pocket instrument called the Campylometer, designed by M. Gaumet, will give the metric length of any straight or curved line, on a map or plane; and the natural length corresponding to the graphic length on maps, with a scale of 1-80,000th or 1-100,000th, or multiples or sub multiples of these scales.

Akron, O., will probably be lighted by eight Brush electric lamps, supplied by one machine. The expense for Carbons is guaranteed not to exceed 1½ cents, per hour, per lamp, or $360 a year for the whole number burned, 3,000 hours. The cost besides this will be power and attendance.

The Twentieth Annual Fair will be held in St. Louis from Oct. 4 to Oct. 9, inclusive. A number of prizes will be awarded for machinery displays, including one of a diploma and $100 cash for the "largest best and handsomest display of steam engines."

PRESERVING WOOD WITH LIME.—The improved French method of preserving wood by the application of lime is found to work well. The plan is to pile the planks in a tank, and to put over all a layer of quicklime, which is gradually slaked with water. Timber for mines requires about a week to be thoroughly impregnated, and other wood more or less time, according to its thickness. The material acquires remarkable consistence and hardness, it is stated, on being subjected to this simple process, and the assertion is made that it will never rot. Beechwood prepared in this way for hammers and other tools, for ironwork, is found to acquire the hardness of oak, without parting with any of its well known elasticity or toughness, and it also lasts longer.

Results of the Millers' Exhibition.

In summing up the permanent results of the Millers' International Exhibition, recently held at Cincinnati, the *American Miller* comments as follows:

Making due allowance for some of the "tall" stories about big sales during the Exhibition, it is undeniable that an immense amount of machinery was sold before the Exhibition closed. One modest firm, who publicly said nothing of their sales, showed us over a dozen orders for costly machines before the Exhibition was half over. From personal knowledge we can say that the amount of business done was quite generally under-estimated, in spite of the exaggerated statements made by some few exhibitors. The number of purifiers, rolls, cleaning machines, middlings and portable mills, bran dusters and cleaners, wheat heaters, diamond machines and other mill appurtenances, is to be reckoned by hundreds. Now, when we consider that most of the machinery exhibited was of a high order, we cannot help seeing that the introduction of so vast an amount of improved machinery into our mills, must favorably affect the whole industry. The inevitable result of the sale of so much improved machinery must be a general toning up in the character of our milling. If A puts in a purifier, or a set of rolls, or a wheat heater, his neighbor B is soon compelled to do the same. Every new or improved machine that is sold performs the functions of a missionary in the locality into which it goes. Therefore, we think that the good effect of the numerous sales of machinery at the Exhibition is too far-reaching to permit of an estimate at this time.

Just as the Exhibition closed, the trade in mill machinery and appliances was very generally complained of as being "flat." But a revival soon took place, and most manufacturers can truly boast that they never did such a rushing business as they were compelled to do in order to keep up with their orders for the months of July and August. This "boom" may only be a temporary affair, but we are optimistic enough to believe that the improvement in business is permanent, though its volume may not, and, in all probability, will not, maintain the proportions of the past two months. It must be remembered that thousands of millers visited the Exhibition and found there collected the best machinery of the country. The educative power of such a collection of improved machinery can hardly be estimated; and it is probably a safe statement to make, that not a single miller visited Cincinnati who did not determine to buy, if he did not buy on the spot, some one or more machines as soon as he was conveniently able. It was impossible for a miller to stay in the Exhibition a half hour without clearly seeing from one to a dozen points in his own mill that were defective. If his mill was an old one, and its appliances antiquated, the conclusion must have been forced on his mind that he was but ill prepared to compete with the enterprising users of the machinery he saw on every side. If he was an "old fogy" the conviction of that fact must have become deep-seated before his progress through Power Hall was completed. How many silent resolves were made in the din of the machinery of that busy scene, we can only guess from the number of machines since sold.

The work of transforming State prisons and other penal institutions into manufacturing establishments, goes on with greater rapidity than ever. At the East Texas Penitentiary are to be erected a number of manufactories. The first shop to be built is a cotton factory, which is now going up. This building is 200 feet long by 55 feet wide, and two stories high, each one being 11 feet from floor to ceiling. There will be partitions dividing the establishment into different rooms necessary for a well arranged cotton factory. This building will contain 85 large windows. Beyond this is to be a wool factory. This building will be on the same plan as the cotton factory, differing a little in size, it being 200×45. Then comes a furniture and wagon shop. This building is the same as the wool factory, 200×45, but its construction is suited to the manufacture of furniture and wagons.

Elementary Principles of the Steam Engine.

BY CHAS. E. EMERY, PH. D.

[*Concluded.*]

The vital forces of an animal are manifested in three forms: 1. The heat evolved in the body, which is due to the combustion or oxidation of the food, the same as if fuel were burned in a furnace. 2. Muscular energy, which also requires the combustion of food, previously prepared in the organs of the body, in proper form to supply the muscles, which are the engines which, in the animal system, are used to convert potential into actual energy. During physical exertion, heat is also evolved, as all have experience. The third vital force we will mention is nervous energy, or that form of force which, on the one hand, stimulates a muscle to contract, and, on the other, appears in forms called mental. Even this nervous energy is supplied from the food. All know that the brain becomes fatigued, like the muscles, and that, under such circumstances, the head after a time becomes perceptibly heated, showing that the energy is being perverted from the desired channels. More than this, Brown Sequard records that a thermopile has been applied to the head sufficiently delicate to indicate, through a galvanometer, a change of temperature at the moment of a thought or of receiving an impression. In using the instrument, "by long practice it was ascertained that a state of mental torpor could be induced, lasting for hours, in which the needle remained stationary. But let a person knock on the door outside the room, or speak a single word, even though the experimenter remained absolutely passive, and the reception of the intelligence caused the needle to swing through 20°."

Evidently all life would soon cease to exist without the sun, and, in the present state of the universe, it is the principal cause of all physical phenomena. We have referred to the sun in connection with the vegetable kingdom, and it is evident that differences in climate and atmospheric changes are due to its influence, modified by the motion of the earth. All the energy thus expended, or which has been expended in previous ages, is conserved, and may be traced and accounted for. Tyndall gives the following beautiful and instructive illustration: "A river, in descending from an elevation of 7,720 feet, generates an amount of heat competent to augment its own temperature 10° F., and this amount of heat was abstracted from the sun in order to lift the matter of the river to the elevation from which it falls. As long as the river continues on the heights, whether in solid form as a glacier, or in the liquid form as a lake, the heat expended by the sun in lifting it has disappeared from the universe. It has been consumed in the act of lifting. But, at the moment that the river starts upon its downward course and encounters the resistance of its bed, the heat expended in its elevation begins to be restored. The mental eye, indeed, can follow the emission from its source through the ether, as vibratory motion, to the ocean, where it ceases to be vibration, and takes the potential form among the molecules of aqueous vapor, to the mountain top, where the heat absorbed in vaporization is given out in condensation, while that expended by the sun in *lifting* the water to its present elevation is still unrestored. This we find paid back to its last unit by the friction along the river's bed; at the bottom of the cascade, where the plunge of the torrent is suddenly arrested; in the warmth of the machinery turned by the river; in the spark from the millstone; beneath the crusher of the miner; in the Alpine saw-mill; in the milk churn of the chalet; in the supports of the cradle in which the mountaineer, by water power, rocks his baby to sleep. All the forms of mechanical motion here indicated are simply the parceling out of an amount of calorific motion derived originally from the sun; and at each point at which the mechanical motion is destroyed or diminished, it is the sun's heat which is restored."

Similarly the energy conserved in past ages conduces to the comforts and necessities of the present, and we are prepared to assign to the steam engine an important position in connection therewith. To do this we must turn back to the Carboniferous period, in an age pre-historic, except as its history is written on the rocks and distinguished by the remains of reptiles and by vegetable deposits arising mainly from a rank growth of great trees, much resembling plants in structure and appearance. Let us, in the words of Dawson, "transport ourselves into the forests and bogs of the coal formation, and make acquaintance with this old vegetation, while it still waved its foliage in the breeze and drank in the sunshine and the showers. We are in the midst of one of those great low plains formed by the elevation of the former sea bed. The sun pours down its fervent rays upon us, and the atmosphere being loaded with vapor, and probably more rich in carbonic acid than that of the present world, the heat is, as it were, accumulated and kept near the surface, producing a close and stifling atmosphere like that of a tropical swamp. This damp and oppressive air is, however, most favorable to the growth of the strange and grotesque trees which tower over our heads, and to the millions of delicate ferns and club-mosses, not unlike those of our modern woods, which carpet the ground. Around us, for hundreds of miles, spreads a dense and monotonous forest, with here and there open spaces occupied by ponds and sluggish streams, whose edges are bordered with immense savannas of reed-like plants, springing from the wet and boggy soil. Everything bespeaks a rank exuberance of vegetable growth; and if we were to dig downward into the soil, we should find a thick bed of vegetable mould, evidencing the prevalence of such conditions for ages. But the time will come when this immense flat will meet the fate which in modern times befell a large district at the mouth of the Indus.

"Quietly, or with earthquake shocks, it will sink under the waters; fishes and mollusks will swarm where trees grew, beds of sand and mud will be deposited by the water, inclosing and preserving the remains of the vegetation, and in some places surrounding and imbedding the still erect trunks of trees. Many feet of such deposits may be formed, and our forest surface, with its rich bed of vegetable mould, has been covered up, and is in process of transformation into coal, while, in course of time, the shallow waters being filled up with deposit, or a slight re-elevation occurring, a new forest exactly like the last will flourish on the same spot. Such changes would be far beyond the compass of the life even of a Methusaleh; but had we lived in the coal period, we might have seen all stages of these processes, contemporaneously, in different parts of either of the great continents.

"Incomplete though our picture necessarily is, and obscured by the dust of time, it may serve in some degree to render green to our eyes those truly primeval forests which treasured up, for our long winter nights, the Palaeozoic sunshine, and established for us those storehouses of heat-giving material which work our engines and propel our ships and carriages. They truly lived not in vain, both as realizing for us a type of vegetation which otherwise we could not have imagined, and as preparing the most important of all the substrata of our modern arts and manufactures."

The following extract from a paper by Prof. Huxley, will be found interesting in this connection:

"Nature is never in a hurry, and seems to have had always before her eyes the adage, 'Keep a thing long enough, and you will find a use for it!' She has kept her beds of coal for millions of years without being able to find much use for them; she has sent them down beneath the sea, and the sea beasts could make nothing of them; she has raised them up into dry land and laid the black veins bare, and still, for ages and ages, there was no living thing on the face of the earth that could see any sort of value in them; and it was only the other day, so to speak, that she turned a new creature out of her workshop, who, by degrees, acquired sufficient wits to make a fire, and then to discover that the black rock would burn. I suppose that nineteen hundred years ago, when Julius Cæsar, was good enough to deal with Britain, as we have dealt with New Zealand, the primeval Briton, blue with cold and woad, may have known that the strange black stone, of which he found lumps here and there in his wanderings, would burn, and so help to warm his body, and cook his food. Saxon, Dane, and Norman, swarmed into the land. The English people grew into a powerful nation, and nature still waited for a return for the capital she had invested in the ancient club-mosses. The eighteenth century arrived, and with it James Watt. The brain of that man was the spore out of which was developed the steam engine, and all the prodigious trees and branches of modern industry, which have grown out of this. But coal is as much an essential condition of this growth and development as carbonic acid is for that of a club-moss. Wanting the coal, we could not have smelted the iron needed to make our engines, nor have worked the engines when we had got them. But take away the engines, and the great town's in Yorkshire and Lancashire, vanish like a dream. Manufactures give place to agriculture and pasture, and not ten men could live where now ten thousand are amply supported.

"Thus all this abundant wealth of money and of vivid life is Nature's investment in club-mosses and the like, so long ago. But what becomes of the coal which is burnt in yielding the interest? Heat comes out of it; light comes out of it; and, if we could gather together all that goes up the chimney, and all that remains in the grate of a thoroughly burnt coal fire, we should find ourselves in possession of a quantity of carbonic acid, water, ammonia, and mineral matters, exactly equal in weight to the coal. But these are the very matters with which Nature supplied the club-moss which made the coal. She is paid back, principal and interest, at the same time; and she straightway invests the carbonic acid, the water, and the ammonia in new forms of life, feeding with them the plants that now live. Thrifty Nature! Surely, no prodigal, but most notable of housekeepers."

The chemical changes which the buried vegetation underwent, while being transformed into coal, are not very material. "Wood or bark, taken as an example of ordinary vegetable matter, consists of carbon or charcoal, with the gases hydrogen and oxygen. Coal has merely parted with a portion of these ingredients in the course of slow and imperfect putrefaction, so that it comes to have much less oxygen and considerably less hydrogen than wood, and it has been blackened by the disengagement of a quantity of free carbon. The more bituminous flaming coals have a larger amount of residual hydrogen. In the anthracite coals, the process of carbonization has proceeded further, and little remains but charcoal, in a dense and compact form. In cannel coals, and in certain bituminous shales, on the contrary, the process seems to have taken place entirely under water, by which putrefaction has been modified so that a larger proportion than usual of hydrogen has been retained. The mechanical change which the coal has experienced consists in the flattening and hardening effect of the immense pressure of thousands of feet of superincumbent rock, which has crushed together the cell-walls of the vegetable matter, and reduced what was originally a pulpy mass of cellular tissue, to the condition of a hard, laminated rock."

These natural deposits of fuel are distributed throughout the world. In the United States there are 120,000 square miles of productive coal fields on the Atlantic coast, and large deposits on the Pacific. The estimated area of the New Brunswick and Nova Scotia coal field is 18,000 square miles, and an arctic coal region is also known to exist. The workable area of the great Appalachian coal field covering parts of Pennsylvania, Ohio, Virginia, Eastern Kentucky, Eastern Tennessee and Alabama is estimated at 60,000 square miles. The whole thickness of the formation is 2,500 to 3,000 feet, the aggregate thickness of the included coal beds over 120 feet in the Pottsville and Tamaqua valley, about 62 feet near Wilkesbarre, and 25½ feet near Pittsburg.

The coal beds of Illinois and Missouri have also an estimated area of 60,000 square miles. A single coal bed is seldom over eight feet thick, but the mammoth vein at Wilkesbarre is 29½ feet thick, while at Pictou, in Nova Scotia, one of the coal beds has the extraordinary thickness of 37½ feet and another of 22¼ feet.

In these great deposits of coal is stored up the surplus energy of past ages. The problem is to utilize this beneficent supply of potential energy and convert it as required into actual energy. By the combustion of the coal heat is evolved, which is the true motive force with which we have to deal in all apparatus for producing motion or performing work. The heat could be applied directly to a metal rod, thereby expanding it, to overcome resistance and upon allowing the rod to cool the shortening of the same could be similarly utilized. The expansion of metals is, however, comparatively small, and a little study as to the necessary details to accomplish the result would show great difficulties in obtaining even moderate amounts of power. Practical engines are, however, constructed in which the heat acts directly upon a permanent gas air, for instance, which has been drawn or forced into a cylinder, such gas being thereby expanded and used to force out a piston, after which it is permitted to escape. Engines of this kind have only come into use where small power is required and a large machine in proportion to the work done is admissible. Perkins has made powerful air engines by working the same air back and forth through a regenerator at a high pressure, but mechanical difficulties prevented its general adoption.

It is well known that gas distilled from bituminous coal will form an explosive mixture with atmospheric air, and engines are in use provided with means to mix gas and air in a cylinder and cause regular explosions, evolving heat and expanding the gases, thereby producing pressure which is received by a piston and connections, and produces mechanical work. Such apparatus may be conveniently employed to obtain small power in cities where gas is manufactured for lighting purposes, but is impracticable on a larger scale.

The greatest success in utilizing heat as a motive force has been obtained by applying it directly to a fluid, which would thereby be developed into the gaseous form, with a large increase of volume, which latter could be reduced at will by the abstraction of heat, and the gas or vapor be re-converted into fluid. The steam engine acts upon this principle, and, in similar manner, engines have been operated by the vapor of fluids which boil at a lower temperature than water. The latter have shown no advantage in direct competition with steam, and are, in fact, of little practical value except to utilize the waste heat from a steam engine, which can be done nearly as perfectly by improvements on the steam engine itself.

We are now prepared to examine in detail the several operations necessary to utilize as actual energy the potential energy of the fuel through the agency of the steam engine, also the various pieces of mechanism used in connection therewith.

We may define steam as water developed into the gaseous form by the absorption of heat. This may be more tersely expressed by stating simply that *steam is the vapor of water*, and recognizing as the distinction between a permanent gas and a vapor, that the former is permanently gaseous, as its name implies, and that the latter is evolved from a fluid by the application of heat, and is capable of being condensed, or brought back to its original liquid condition. We are apt, however, to associate the name vapor with the cloudiness caused by chilling

the aqueous vapor in the atmosphere, whereas true steam is colorless and invisible.

If the flame of a lamp be applied to the bottom of a glass bottle partially filled with water, the particles of the latter first acted upon will be expanded and thereby become lighter so as to be crowded upward by the surrounding heavier and cooler particles. In this way an action known as convection, or circulation, is established, consisting of an upward current above the source of heat, and return currents at other points, by which means all the particles of water are successfully heated. Without this action the water would be heated very slowly, as it is a very poor conductor of heat. As the heating progresses the bubbles of air contained in all potable water will be driven off, and the temperature will rise until a visible vapor is seen above the surface of the liquid; soon after this the tension of the vapor becomes equal to the external pressure, when true, colorless steam is liberated freely, breaking up the surface of the liquid as it escapes, in other words, causing the water to boil. The temperature at which boiling takes place depends, as will be seen, upon the pressure to be overcome. If the vessel be open to the atmosphere, and the barometer indicates 2992 inches, equivalent to 14.7 pounds pressure, very nearly, the temperature of the boiling water and of the escaping steam will be found to be 212 degrees Fahrenheit. This temperature, in fact, is so certain and definite under the conditions named that it is used as one of the fixed points in graduating thermometers. If the vessel be closed, the internal pressure will rise as evaporation progresses, and the temperature will also rise, while, on the contrary, if the steam be allowed to escape into a partial vacuum, that is a space from which air, or other gas, has been partially removed so as to make the pressure less than that of the atmosphere, the pressure and temperature of the steam in our ideal boiler as well, of course, as the boiling point, will correspondingly fall. For every pressure of steam there is a corresponding temperature, which has been ascertained by experiment, and is shown by the tables published in standard works on the subject.

Apprentice Papers.

BY CHORDAL.

III.—GENERAL PROPERTIES OF MATTER CONTINUED.

Almost all substances possess some peculiarity in structure; some variation in the size of molecules; some variation in the distance between them; and, consequently, some variation in their cohesion or strength. Many substances may have their structure altered by various processes, and thus take a new nature.

If we examine a piece of soft steel, we notice that it is composed of rather coarse grains. If we strike this steel with some hard substance, we find that the particles are moved, and the steel is bruised and dented. By means of a file we can even pull particles away from the mass and reduce its size. We judge by this that the cohesion of soft steel is not extraordinarily high. The particles do not strongly object to being moved out of their usual position. We may bend the piece of steel and thus change the relative position of every particle, and the piece will stay bent, thus indicating that the particles are not tightly bound together. If we take this same piece of soft steel and heat it till red, and then suddenly cool it in water, or other cold matter, we will find that the molecular structure is greatly altered. If the piece be broken, it will be noticed that the grains are very fine and very closely compacted together. The cohesion of the particles has increased so very much, that it is found almost impossible to separate them. Hard blows with the hardest of substances will not move the particles so as to form dents.

The hardest of files will not separate any of the particles from the mass. It is now hard, and its cohesion is so great that it will move the particles of almost all other substances, against which it may be forcibly applied. This quality fits hard steel for tools, &c.

If an attempt be made to bend this hard steel, it will be found that the particles are bound together so tightly, and resist a change in position so powerfully, that they will not move until sufficient power is applied to separate them entirely. The piece of steel breaks instead of bending. Hardness is always accompanied by brittleness. If we heat this hard steel and cool it very slowly, instead of suddenly, we again have soft steel instead of hard steel; malleable steel instead of brittle steel; particles far apart and loosely held, instead of closely packed and powerfully held together by cohesion.

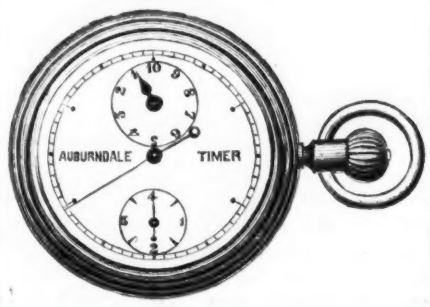
Copper is exactly the reverse of steel in the way its cohesion is affected by sudden heating and cooling. Soft copper heated red, and suddenly cooled, becomes still softer and more ductile and malleable. Soft copper heated and slowly cooled becomes harder and more brittle.

Glass is a very hard and brittle substance. Its particles can be moved on each other only by a harder substance. Diamond is very much harder, being, in fact, the hardest substance known.

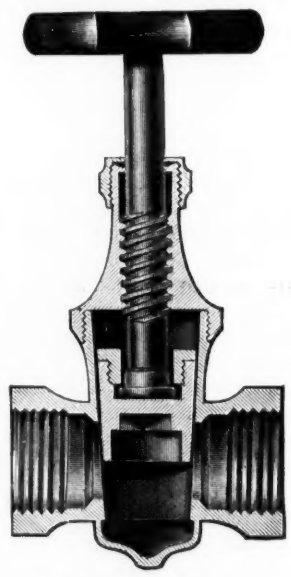
Hard substances, owing to their brittleness, can often have their fine molecules broken away by light blows. A highly polished piece of the hardest steel, if exposed to the action of a dusty wind, will become dull and rough by reason of the outside particles being hammered and cracked off by the millions of light blows received from the flying particles of dust. The diamond is so very hard, and its particles so extremely cohesive, that it withstands for many years the hammering action of the dusty air. A false diamond, made of the hardest of glass, and polished in the same way and as highly as a real diamond, will reflect the light with great brilliancy and will appear like a diamond, but a few hours' exposure to the common air serves to break away and deaden its comparatively soft surface.

As before stated, the combination of two different substances often produces a substance unlike either. Thus copper and tin are both very soft, ductile, and malleable metals. Nine parts of copper and one part of tin, melted and mixed, form the alloy known as gun metal. This alloy, unlike either of the metals of which it is formed, is very hard and tough, and possesses comparatively no malleability or ductility. Of the two metals composing this alloy, tin is much the softer, yet an increase in the proportion of tin in the alloy *hardens* it. When the alloy is one-third tin and two-thirds copper, it is so hard that steel tools will not cut it, and so brittle as to fly to pieces when subjected to light blows.

In speaking of the molecular change in steel when suddenly cooled after being heated, it was stated that soft steel allowed its molecules to be moved around on each other by denting or bending, and that the molecules will stay in any new position where put. Thus a blow on soft steel leaves a dent, or a new arrangement of the molecules. When the steel is hard, no dent can be made, because the molecules refuse to move.



If, instead of cooling the steel suddenly, it be cooled neither suddenly nor slowly (a process called tempering) we will have a new condition of the molecules, and new properties in the steel. It will be neither very hard nor very soft. If it be struck with a hard substance, the molecules will move, but will immediately return to their old position. The steel can be dented, but the dent instantly disappears. When the steel is bent it instantly straightens again with considerable force. Steel in such condition is fitted for springs. When a material is composed of molecules, which will allow themselves to be displaced, and still return to their original position, that material is said to be *elastic*. Glass, though hard and brittle, is very elastic. Ivory is very much so; india rubber is elastic to a remarkable degree, and spring steel, and spring tempered metals generally are very elastic. If a lead ball be dropped on the pavement, it will be flattened on the side which strikes. The flat part will stay flat, because the lead has no elasticity. If an india rubber ball be dropped on the pavement, it will be flattened very much more than the lead ball, but the elasticity of the substance is so great that the particles all resume their old position with such force as to bounce the ball upward to a considerable height, and when the ball is examined, no sign of the flattening is seen.



ACME GATE VALVE.

Some substances may be squeezed or compressed into very much smaller bulk, such substances are said to be compressible. If, upon being released, they return to their former bulk, they are of course elastic. All substances are to some extent compressible. Under great pressure, the ether is crowded out from between the atoms and the substance becomes more solid or *dense*. The real *matter* in substances is so little, compared with the ether between the atoms that it has been stated that the whole earth, if the atoms were pressed into actual contact, and made perfectly dense, would not fill a square foot of space. Such a statement seems hard to believe, but will serve to bring our minds to a sense of the *porousness* of all matter.

A cubic inch of lead can be compressed into one-tenth of that bulk, and it will remain so, and be more dense or solid. A room full of air can be compressed into a thimble, but will immediately expand to its full volume when released, owing to its great elasticity.

A New Oil Can.

The oil can illustrated on this page has some peculiar features. It requires no vent and no pressure to eject the oil as the drip valve, during oilings, supplies sufficient air to cause a steady flow, and after oiling all drippings on outside of the spout return into the can. This arrangement, doubtless, prevents waste of oil. It is convenient to fill and clean out, and has a reversible spout which can at once be changed to any direction. The spout can instantly be cleaned by blowing through the vent. The construction is simple, and its cost is no more than that of oil cans now in use. This oiler is now being introduced by H. Prentiss & Co., 14 Dey St., New York.

The Auburndale Timer.

We illustrate, herewith, a new style of watch for various kinds of timing, which marks small fractions of a second with great accuracy. The Auburndale Watch Co., Boston, Mass., manufacture three different kinds, beating $\frac{1}{4}$, $\frac{1}{8}$, and $\frac{1}{16}$ seconds, respectively. They also make them with "split second hands," or two second hands running together, one of which can be stopped, while the other moves on regularly, which arrangement is very handy for timing revolutions of shafts, and for general use in machine shops, where accurate tests are made.

The watch is provided with three dials, the smallest of which marks the fractions of a second, while the one shown at the top marks minutes up to ten, and the largest one marks seconds.

The crown at the right is the "starter and stopper," and the little knob below is for adjusting the split second hand.

Acme Double Gate Valve.

The requirements of a double gate valve, in order to be successful as a water and steam valve, are, among other things, that it will keep tight under any circumstances, at the same time possessing great durability and strength. It is claimed that the valve herewith illustrated presents these qualities in the superlative degree. It has been in use some three years under severe conditions with evident satisfaction to engineers. It has a circular conical plunger-valve-plug, swiveled to the stem, and fitting into a circular seat, which is thus made perfectly tight at both inlet and outlet. By swiveling the plug to the steam, friction is removed, and a perfect fit is obtained between plug and seat. The valve can also be easily ground in without disconnecting from the pipe. A. Aller, 109 Liberty St., New York, is general agent for the manufacturers.

The American Railway Improvement Co. is a construction company recently incorporated under the laws of Colorado. Its officers are: General G. M. Dodge, president; James P. Scott, son of Thomas A. Scott, vice-president; Francis W. Baldwin, Denver, secretary; Charles F. Woerishoffer, treasurer. The company has under its charter extensive powers, which include the right to build and repair railroad and telegraph lines within the limits of the United States and Mexico. It has taken already the contract for the building of the New Orleans Pacific Railroad, and now has under consideration several other important engagements. The New Orleans road extends from Shreveport to near Baton Rouge, and to New Orleans, about 325 miles.

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CONTENTS.

PAGE.

New Engine Lathe—60 Inch Swing 1
Construction and Operation of Steam Traps. Wm. J. Baldwin 1
Letters from Practical Men 2
Compound High Speed Air Compressor 3
Hoisting Machine for Elevators 4
The Machinist's Trade and Industrial Education. Prof. S. W. Robinson, Dep't of Mech. Eng., Ohio State University 4
Wood Printing Machine 5
English Co-operative Societies 5
Results of the Millers' Exhibition 5
Elementary Principles of the Steam Engine. Chas. E. Emery, Ph.D. 6
Apprentice Papers. III. Chordal 7
A New Oil Can 7
The Auburndale Timer 7
Acme Double Gate Valve 7
Methods of Selling Machinery 8
Black-Listing Workmen 8
Employers Appreciation of Shop Improvements by Workmen 8
Questions and Answers 9
Manufactures 9
Machinists' and Engineers' Supplies 10
Iron Review 10
Metal Review 10

Methods of Selling Machinery.

The present remarkable activity in demand for machinery, particularly machine tools, and wood working machines, develops, in a high degree, the defects of a few of the systems practiced for making sales. A man who knows positively that he has originated or secured control of a superior machine, is likely to think, when starting to manufacture it, that the details of selling will be extremely simple, over which it is hardly necessary to spend much time in deliberation. If he has never had experience in finding a market for machinery, he is likely to meet with some discouraging drawbacks. The fact is, that it requires peculiar ability to sell, as well as to design and construct machinery, and, while an individual may possess the latter beyond question, he may be, and frequently is, altogether deficient in the former. The heads of some of our most successful machinery establishments, under whose management many of the most advanced machines have been brought out, are neither mechanical engineers nor machinists, but are strong in executive ability and methods of selling their productions, thus being enabled to distance their progressive mechanical competitors. A few machinery manufacturers prefer to delegate their selling entirely to agents, while others prefer to ignore agencies. As an example of the former, we may refer to our issue of Aug. 14, where we described a new portable engine which the manufacturers have decided to sell *to dealers only*. They probably see special advantages in this plan, and it cannot be denied that if the engine is to be sold by dealers at all, it must be more satisfactory to the latter than to compete with the manufacturers for the same customers.

The practice of selling through agents at a fixed retail price, and then cutting that price *sub rosa*, cannot be condemned too strongly. Where it costs less to take off a commission from the price of a machine, as a regular business, than to seek customers directly who desire to use the machine, the best plan is unquestionably to let the agents find the customers. But if a system is adopted which will insure the securing of a sufficient number of customers at low cost, the profits of a shop will be larger, if agents are not in any way depended upon. Where it is necessary, in order to keep the agency active, to consign machines on sale, the manufacturer requires not only surplus capital, but a large amount of patience. However, the amount of business will generally be larger if a number of local agents are dealt with. The plan of sending out machinery upon trial, to be paid for only if found satisfactory, does not need to be pursued long to lead to its abandonment in disgust. Too many parties try to keep machines on trial until they are nearly worn out before paying for them. We would advise those about to start in the machinery business to study carefully the most feasible plans for disposing of their productions before offering them to the public.

Black-Listing Workmen.

A number of manufacturers in various localities and lines of business have adopted an expedient as a result of their contest with Trades-Unions, the policy of which, at least, it is difficult to defend. We refer to the plan of keeping a list of names of workmen who have either taken part in a strike, or belonged to Trades-Unions, and circulating it among other employers. Now, strikes may be just or unjust, fair or unfair, but the manufacturer who goes out of his way to report the names of striking workmen, in this fashion, usually troubles himself little about the justice of the controversy.

As a rule, strikes are unwise expedients, which can be prevented, if employers and men will show a disposition to be fair and reasonable. The workman who joins in a strike because a Trades-Union to which he belongs commands him to do so, though without grievances of his own, pursues a line of action no more defensible than that of the employer who puts himself to the trouble of black-listing among other employers men who are obnoxious to him.

As a matter of policy, manufacturers who adopt this plan, adopt the methods of the very organizations whose existence they condemn, and, by so doing, lower themselves to the same level, while setting an example to their men, which is very liable to result in additional Trades-Unions, and more need of black-lists.

Employers Appreciation of Shop Improvements by Workmen.

In previous issues of the AMERICAN MACHINIST attention has been called to the fact that there is, in too many cases, a barrier between the employer and employe, and, as a result, each feels a comparatively small interest in the welfare of the other. We have also recommended as a remedy, a closer relation between the parties, so that the workman will take the same interest in the success of his employer, and handle the material given him as careful and economically as if it were his own. A certain establishment in Dumbarton, Scotland, has recently originated a plan as an inducement to their workmen, which will, of course, result in adding greatly to the value of the class of machinery produced by them.

They state that they have noticed during the past two years many improvements in methods of work and appliances introduced into their yard, and very readily recognize the advantage accuring to their business from these efforts of skill, and are desirous that these improvements should not pass unrewarded. They have, therefore, decided that the authors of such improvements introduced hereafter shall have a claim upon the firm for reward ; and to enable these claims to be readily and easily adjusted, they have appointed a committee of awards. The rewards are to be given as follows: To any one who has either invented or introduced a new machine or hand-tool into the yard ; to anyone who applies existing machinery or hand-tools to a new class of work ; to anyone who has discovered or introduced any new method of carrying on or arranging work ; or generally to anyone who has made any change by which the work of the yard is rendered either superior in quality or more economical in cost. The awards are not to be less than £2 and not more than £10, but the firm may give more if satisfied that the invention deserves it.

We are aware of circumstances in which workmen were kept at work, simply because they could not be dispensed with, but just as soon as an opportunity offered, and business became a little quiet, the men were discharged and the shop cleaned out. When fresh orders were received new men were hired, and much time lost and inconveniences experienced before the new hands could get initiated into the customs of the shop, and the different methods of doing work. This resulted in more or less damage to the employer. Since our first introduction to the shop referred to, we remember but one instance where valuable improvements were made in the adaption of tools to facilitate the turning out of work.

The right of invention and improvement was a sovereign right that the proprietor reserved for himself. In fact, he was one of the kind of men whom we have heretofore spoken of as knowing it all, and considered any ideas advanced by an employee as of little value compared to his own, when in fact the man who does the work is really the one to whom we should look for improvements. Men do not stumble over valuable ideas which are afterwards patented and the community benefitted. But the most valuable inventions have been the result of mature deliberation and study, supported by a long and careful experience. Workmen should be encouraged and allowed to develop their inventive genius, and both parties will receive the benefit.

We are aware that some manufacturers will raise an argument against this assertion, contending that if the men are petted they will make some invention and secure it in such a way that the former will be left in the lurch.

This is a slim excuse, for there are numerous ways by which such a result may be obviated. As a precaution, an employer should satisfy himself that he is dealing with a man who is honorable and upright before offering him his confidence and co-operation. We give the following illustration : A certain manufacturer had an engineer who was ingenius, and was constantly at work trying to devise some means by which he could reduce a coal bill of $28 or $30 per week. He made a proposition to the proprietor for a small appropriation for experiment in devising a way to burn coal dust. The proprietor was unwilling to comply with the request of the engineer, so he had to either give up his ideas, or go ahead and pay his own expenses, which he did. He secured a blower, and with what scrap iron he could pick up about the place, succeeded in perfecting a method of making plenty of steam, and at an expense of about $4 per week. The fuel used was coal dust, which could be bought at the yard at 25 cents a load. As a result, the proprietor was pleased, and told his friends, chuckling over the great reduction in his coal bill, but did not increase the salary of his engineer, or even reimburse him for the outlay incurred by his experiments.

It is well to inquire, right here, whether this engineer will ever be likely to make another invention while in the employ of such a man? We think not, and will add that if the proprietor had encouraged the inventive genius of this engineer, his assistance would have been heartily appreciated, and, after properly securing the invention, not only would he have experienced the benefits himself, but so would the comunity at large.

The offer of the Dumbarton concern referred to, applies to all improvements which are not patentable, as, for instance, the adaptation of tools and devices to certain classes of work. Employers should see that their foremen are of that class who are not afraid of losing their positions through the efforts of some journeyman trying to show superior skill. We have known a shop to become destitute of good workmen, simply because the foreman had only a limited amount of knowledge of his business, and he would not have a man at work under his direction who was better qualified to fill the position than himself. The success of any enterprising firm or manufacturer depends largely upon having a proper superintendent and foreman. When a foreman becomes jealous of his workmen, it is time that there should be a change in that shop, as it will result disastrously to the business and finances of the proprietors. The example referred to, might with safety be imitated by many of the manufacturers in this country.

In another column, Prof. Robinson, of the Ohio State University, urges that of the higher grade of mechanical or technical schools, this country has enough. Doubtless his praiseworthy efforts toward building up a mechanical engineering department that his institution may be proud of, have given him special opportunities for observation in this direction. But of the lower grade there certainly are not schools enough, if by the word "school," we are to understand places where young mechanics can meet and learn of each other. Of these there is no danger of our ever having too many.

Just after our last week's notice of the Newspaper Mis-Directory, issued by George P. Rowell & Co., was put in type a little incident occurred which so well illustrates the subject that we admit it here. An order was sent us by the above firm, instructing us to insert a certain advertisement for a specified time in our advertising columns, sending them bill for an amount named in the order, and which was only about *one-third* of what they had been repeatedly advised were our invariable rates. The order was promptly declined, with the remark

that their action in this instance formed about "the sublimest piece of effrontery which had yet come to our notice." Whatever may be the habitual method of the above firm with the newspapers with whom they deal (and doubtless there are struggling sheets which would submit to shaves of this kind), the AMERICAN MACHINIST does not do business on that plan.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common sense methods.

(1) W. W., Pittsburg, Pa., writes: In your number 5, dated January 31, 1880, you give an illustration of a "Double-Acting Cam Drawing Press." The illustration shows a spur wheel in perspective. I have been trying to find the centers of the curves that form the wheel but have not been able. I wish to make a drawing of a similar wheel in perspective, and would be much obliged if you will give me a drawing, showing the manner of drawing the oval for the wheel, also how the centers are found to which the lines forming the teeth tend. *A.*—The illustration to which you refer is not a mechanical drawing, neither is it mathematically correct. Nearly, if not quite, all of the drawings made for wood engravings, are drawn free hand, as it would take much more time to draw with instruments. The accuracy of free hand drawings depends upon several conditions, viz.: the skill of the draughtsman, the price to be paid for the wood cut when finished, and the quality of work desired. To lay out a spur gear in perspective we refer you to most of the books on perspective drawings of machinery, which will give you the desired information. One of the best treatises on this subject is The Practical Draughtsman's Book of Industrial Design for Machinists and Engineers, by Wm. Johnson.

(2) H. B., Paterson, N. J., asks: Will you kindly inform me how to figure out the amount of water used to generate the steam used by a steam engine, from an indicator card? Where I work there is an engine having a cylinder 23″×60″; the average pressure is about 22 lbs., and the terminal is about 12 lbs. What would be the amount of water consumed per hour; the piston makes about 610 feet per minute? *A.*—The amount of water in producing a steam engine diagram can only be determined approximately from the terminal pressure. A more accurate way was described and the subject treated in full in Engineering Popularized No. 3, by Wm. Lee Church, which was published in the AMERICAN MACHINIST for March, 1879.

(3) S. L. G., Kingston, N. Y., writes: I would like to know if there is any way to soften white or silver iron so as to drill or chip it. I have tried several receipts but all have failed. *A.*—White iron in its natural state is very hard and brittle, resisting the application of both chisel and file. It is used principally as an alloy for mixing with other irons. In its natural state it can be worked only by the use of special tools, and then only with the greatest difficulty. This iron may be annealed by removing a portion of its carbon, which may be done by using the process for making malleable iron castings, as follows: The white iron is to be put into a steel or other converting furnace, together with a suitable quantity of iron-stone iron ore, some of the metallic oxides, lime or any combination of these substances previously reduced to powder, or any other substance capable of combining with or absorbing the carbon of the crude iron. *Heat* is then to be applied of such intensity, to effect a union of the carbon of the cast iron with the substances made use of. The application of heat should be continued so long as may be found necessary to make the cast-iron either partially or perfectly malleable, according to the purpose for which it is intended. To effect complete malleability ½ to 2-3 of its weight of the other substance is found necessary, but a much less quantity will suffice if partial malleability is required. Towards the close of the process the heat must be very great, and extensive experience is required to conduct the details successfully.

(4.) C. O., New York City, writes: I am in something of a pickle. Will you be kind enough to advise me what to do? I have two Otis hoisting engines, one of which is an oscillator. The boiler is 14 feet long, and in design is a horizontal return tubular. It has 30 tubes of 2½″ diameter and a fire box 3 feet by 4 feet. The draft flue passes over the top of the boiler, then down by the side 7 feet, connecting with an underground flue 18″x30″ which extends a distance of 50 feet, when it enters an old house chimney. This chimney has two flues one of which is 3″x8″, and the other 8″x10″. The height of this chimney is 125 feet, projecting 7 feet above the roof, the 7 feet having been lately added. The ash pit is 15 feet deep. We burn egg coal, which is rather dusty, but the trouble is with the draught, which canges, causing the fire and gas to come back through the bars, gradually smothering the fire. We sometimes have to haul the fire or effect a temporary relief by building a fire of shavings introduced through a door at the base of the chimney. This has the effect of changing the draught, but it will frequently separate itself, causing great annoyance. I have thought of running live steam from the safety-valve to the flue to start the draught. Would this give any relief, and where should the steam be applied? Is the trouble with the chimney or underground flue? Do flues running underground ever give satisfaction? I have never experienced such trouble before in my experience of 15 years as an engineer. The owners seem to think everything is right, the trouble being with the engineer. The party who executed the present plans are old heads of thirty years experience. When steaming with draught at its best there is not heat enough in the chimney to be felt from the outside. Will we be able to get around this without using a blower? Will you show me a way out of this predicament, as I wish to show your answer to the owners, and let them suit themselves about it. *A.*—One of the principal causes of failure in this case, is the bad proportion of boiler. There are 12 square feet of grate surface, and only a trifle over one square foot of tube opening to allow the gases to pass. Instead of this, there should be at least 1¾ square feet, and, in this instance, 2 square feet would be better. The underground flue, on the other hand, is too large, as it contains 360 square inches, while 220 would be ample. The chimney with double flues is too small for the grate surface, as it should contain 220 square inches. It has now only 160 square inches. The temperature of the underground flue, and also the upright chimney flues, must be determined before the final decision. If the temperature of the underground flue, at the center of its length, is less than 600°, the draught will be impaired. If the temperature at the bottom of the upright chimney flues is less than 520°, the draught will be unsteady. The use of a large underground flue, and contracting it to half the size at the upright flues, accounts for about one-half the trouble. There should be no enlargement in a smoke flue; although, if the order of things were reversed, and the 18″×20″ was upright, and the two 8″×10″ were underground, the draught would be better. It will be impossible to form perfect combustion on the 12 feet of grate, with only thirty 2½″ tubes to take away the gases, without the use of artificial draught. The dropping of the flue from the top of boiler will not interfere with draught, if the elbows and passages are large enough and free from soot. The elbows should be about fifteen per cent. larger than the straight pipes or flues, and the corners rounded instead of square, if possible. The chimney should be not less than fifty feet high, and the top clear of neighboring walls and other obstructions.

Business Specials.

40 cts. a line for each insertion under this head.

Thomas D. Stetson, Patent Solicitor and Expert in Patent Cases. No. 23 Murray St., New York.

Alfred Wilkinson, Engineer and Mechanical Draughtsman, can be consulted on all matters connected with the economical use of steam; 506 Walnut Street, Philadelphia. Engines indicated, power measured and valves adjusted for best results.

John A. Caldwell, Mechanical Engineer, 94 Liberty Street, New York.

Blowers for all purposes. Exeter Machine Works, 50 Federal Street, Boston.

American Watch Tool Co., Waltham, Mass. Lathes, Watch Case, and Clock-Making Machinery.

See Christiana Machine Co.'s adver., next number.

The $4 Drill Chuck, 0 to 9-16. Sent free on receipt of price. Address A. F. Cushman, Hartford, Conn.

Dies for every purpose. Stiles & Parker Press Co., Middletown, Conn.

Repairs to Corliss Engines a specialty. L. B. Flanders' Machine Works, Philadelphia, Pa.

Paper Making Machinery—Makers of above from fibrous material as wood, esparto grass, etc., send address to Joshua Rose, P. O. Box 3306, N. Y. City.

Engines, Hoisting and Pumping Machinery for Mines. The Band Friction Hoist, which is the safest, simplest, strongest and best in the market. Also, Friction Clutches. Address, Webster Camp & Lane Machine Co., Akron, O.

Rules for Engineers, and Removal of Scale in Boilers. Send for Circular. Ranken Scale Co., 50 Federal Street, Boston.

Dixon's Traction Belt Grease. Dixon's Founders' Perfect Wash. Dixon's Plumbago Foundry Facing. Dixon's Graphite Machine Grease. Dixon's Everlasting Graphite Axle Grease. Dixon's Dry American Graphite Perfect Lubricator. Send for explanatory circular to Dixon Crucible Co., Jersey City, N. J.

Manual of Power for Machines, Shafts, and Belts, with the History of Cotton Manufacture in the United States, by Samuel Webber, C. E., copyrighted 1879. Only work of the kind extant; 240 pages. Price $3. Address, D. Appleton & Co, New York, or the author, Manchester, N. H.

Sheet Metal Presses. Ferracute Co., Bridgeton, N.J.

Engines Indicated—Power Measured. W. H. Odell, Box 274, Yonkers, N. Y.

John Douglass, common and fine patterns made to order, also car wheels, working models, and experimental machinery. Shop at Washburn, Hunts and Co's Wheel Foundry, cor. Warren and Bay Sts., Jersey City, N. J.

Vertical and Horizontal Pumps. Capacity from 100 to 35,000 galls. per minute. Simple, Efficient, Economical, Durable. Used by more than half the tanners and paper makers of the country. Horizontal and Vertical ENGINES, from 10 to 30 H. P., for long continued hard work. Prices, 40 per cent. below other makers. Send for circulars. Heald, Sisco & Co., Baldwinsville, N. Y.

MANUFACTURES.

The Potter Ore Bed Co., of West Stockbridge, Mass., has been incorporated with Fred S. Potter, Pres., and Wm. M. Kniffen Treas.; Capital, $25,000, in shares of $100 each; for the mining, smelting and selling of iron ore, and the manufacture and sale of pig iron.

The Sand Blast File Sharpening Co., of Wilmington Del., have the right to the process indicated in their name in all the United States west and south of New York State to the Rocky Mountains and the Gulf of Mexico, and are prepared to furnish apparatus to shops or factories with license. This process for sharpening files was described with illustrations in our issue of Oct. 18, 1879. The Pennsylvania R. R. shops at Altoona, Pa., have started to use the process.

The North Star Iron Works Co. is a new corporation which has purchased machine shops in Minneapolis, Minn. V. L. Price is the practical man.

The Eureka Cast Steel Company of Chester, Pa., are enlarging their works so as to increase their size about one-third.

J. H. Boone & Co., of Norristown, Pa., will soon put their blast furnace in operation again.

Beggs & Son's Foundry, Chattanooga, Tenn., will be much improved by the immediate erection of a new machine shop, covering ground space 35x60 feet, two stories, second floor for pattern shop. Their specialty is grates and fronts. Stoves and sorghum mills are also made.

L. Morse & Son, of Athol, Mass., have nearly completed a large addition to their furniture factory, so that it now measures 40×100 feet. They employ thirty hands now, but will soon increase their force to fifty.

A company is now putting up buildings at Reading, Mass., for the manufacture of rubber. The buildings now in process of erection include the main edifice, 500 feet in length, by 60 feet in width, also boiler, engine and wash house, 60 feet square. The company will be known as the Mayall Rubber Co. When in full operation, about 300 operatives will be employed.—*Boston Commercial Bulletin.*

John Stoddard & Co. are making large additions to their agricultural implement manufactory at Dayton, O., having lately put up a large four-story brick addition.

The Dayton, O., machine building, nearly destroyed by fire, is now fully repaired and a portion of the building occupied by a paper box factory.

Geo. H. Barrus, engineer, has opened an office at 87 Milk Street, Boston, Mass., where he will attend to all matters connected with his profession. He gives attention to steam engine indicating, as well as hydraulic and other elevator machines.

The famous New York Iron Mine, owned by the Hon. Samuel J. Tilden, is to have one of the Norwalk Iron Works Co.'s Compound Air Compressors of one hundred horse power. These are the monster machines which our South Norwalk people have seen drawn from the Iron Works' railroad switch, about one each week, during the past summer. They are also building compressors of the same size for parties in St. Louis, Columbus, Ohio, and Hannibal, Mo.—*South Norwalk Sentinel.*

Peter Gerlach, & Co., manufacturers of saws, stave and barrel machinery, Cleveland, O., have received a cablegram order from Russia for three of their patent champion barrel stave sawing machines.

The Cuyahoga Brass Foundry and Smelting Works is a new establishment, located in Cleveland, O. They are to manufacture anti-friction metals, solders, car journal brasses, brass castings, babbit metal, tinners' and plumbers' solder, stereotype and electrotype metal, bar lead, bar tin, antimony, etc. The office is 73 Ontario St.

The Cleveland Co operative Stove Co. are remodeling and arranging their new establishment at St. Louis.

Moulton & Baker, Milwaukee, Wis., have formed their concern into a joint Stock Co., with a capital of $10,000, for making small drills and special tools.

Thompson & Nathanson, Milwaukee, Wis., have moved into their new shop, and have increased facilities for filling orders for machine bits.

Hoffman & Billings, Milwaukee, Wis., have completed their new foundry and machine shop, and are stocking their machine shop with Sellers' tools.

The New England Ironclad Steel Horseshoe Co. is a newly organized Boston corporation who are to manufacture a new style horseshoe. The officials of the company are: Theo. S. Very, President; J. H. Rice, Secretary and Treasurer.

Ex-Governor Coburn is building a woolen mill at Skowhegan, Me., which is to be 150 by 58 feet, and 3 stories high.

Hollingsworth & Whitney will soon build a pulp mill on their unoccupied land at Gardner, Me.

Merriam, Hall & Co., of Leominster, Mass., have just built an addition to their chamber furniture factory four stories high, and measuring 16x25 feet.

The Boston Belting Company have contracted to furnish belting for two large elevators in Chicago, one in Toledo, Ohio, and one in St. Paul, Minn. The main belts were 54 inches in width, being the largest ever made. The four orders aggregate over $100,000.

The Hull and Nantasket Beach Railroad Co. has been incorporated in Mass., with Geo. R. Eager, R. M. Pulsifer, H. T. Litchfield, E. P. Call, A. J. Tower, F. A. Hobart, Wm. Proudman, Jr., John Lothrop and Wm. R. Clark, Directors; Alfred Schoff, Clerk and Treas. Capital, $50,000, in shares of $100 each. The termini of the proposed road are Windmill Point in Hull, Strawberry Hill in Hull, and the northern terminus of the Nantasket Beach R. R.; estimated length about three miles, wholly in the town of Hull. Gauge four feet eight and one-half inches.

The machinery at the Cincinnati Industrial Exhibition this fall will be driven by a Reynolds-Corliss engine built by E. P. Allis & Co., Milwaukee, Wis.

Wilder Machine Works, Chattanooga, have much work on hand, and will increase the working force shortly.

Merrimac Valley Telephone Co., of Lawrence, Mass., has been incorporated, with Wm. S. Knox, Pres., Albert D. Swan, Treas. Capital, $100,000, in shares of $100 each, for the establishing and conducting of a telephone exchange, in the city of Lawrence, and the towns of Andover, North Andover and Methuen, under contracts with, and as agents of, the American Bell Telephone Co., for the introduction of private telephone lines.

C. Beck & Co. have just completed a new saw-mill, with fine appointments and a capacity of 10,000 feet, at Penetanguishene, Ont.

Buchanan, Bolt & Co., wire cloth manufacturer's, Holyoke, Mass., have a loom which weighs over eighty tons and will weave a cloth 115 inches wide, and is supposed to be the largest of the kind in the world.

A gas tank, which it is said will be the largest in the world, is building at the Continental Iron Works, Greenpoint, N. Y., for the Municipal Gas Light Company, of New York City. It will be 285 feet in circumference, 40 feet high, and of 1,250,000 cubic feet capacity.

William Cooke, 6 Cortlandt St., New York, has just put a No. 7 Root's Blower in for the Bay State Iron Works, of Boston. The machine discharges 10,000 cubic feet of air per minute, and delivers it at a pressure of two pounds per square inch. It makes but 160 revolutions per minute, and the company are much pleased with it, and claim great economy in its use. The demand for these blowers is far in excess of the supply, the eastern agency alone sending the manufacturers more orders than they can fill.

John Englis & Son are constructing, at their ship yards in Greenpoint, the largest propeller ever built at this port, for the New York and Charleston Steamship Company. It will be of 2,000 tons burden, with accommodations for 100 first-class passengers. The dimensions of the vessel are as follows: Length of water line, 270 feet; on deck, 285 feet; width of beam, 40 feet; depth of hold, 21½ feet. Of boilers there will be six, each 10 feet 9 inches long, and 10 feet in diameter, the boiler shells to be ¾ inch in thickness. The engine will be a compound one, with cylinders 36 and 60 inches, and a stroke of 54 inches. The propeller screw will be 14 feet in diameter, with a pitch of 22 feet. The steam pressure to be carried is 80 pounds to the square inch. It is intended to launch the vessel about October 1. Its value is placed at $250,000.

Machinists' and Engineers' Supplies.

NEW YORK, September 9, 1880.

During the past week the amount of business transacted and sales made in the supply business has been indicative of a healthy condition of trade, and all that could be desired. There is a scarcity of forged goods, such as hammers and sledges. The principal reason for the present scarcity of some classes of goods is that orders have been given and the buyers all desire to get their orders filled at once.

One of the best indications of the sound condition of trade is that there are large sales of mechanics' tools, showing that the mechanics are nearly all at work, and are replenishing their stock, which suffered greatly during the period of low wages.

Prices of supplies have not advanced since our last report.

Wrought iron pipe continues in large demand and the manufacturers look to higher prices.

J. M. Montgomery, 105 Fulton Street, New York, has lately returned from Europe, where he has been selecting an extensive stock of assorted files and other fine tools; also a stock of bar steel and wire. An invoice of these goods has just been received.

The Buckeye Engine Co., of Salem, Ohio, office at the Coal and Iron Exchange, New York, have just issued a new and enlarged catalogue of 58 pages, describing their engines, together with new and valuable engineering information. Additional details and improvements are described and illustrated.

We have received a copy of a new circular and price-list of Patent Hot Polished Shafting from the Akron Iron Co., Akron, O. The advantages of this shafting are summed up as follows:

1st. It is perfectly round and straight.

2d. It can be rolled accurately to any desired gauge, obviating the necessity of lathe work.

3d. It has the beautiful blue finish of Russia sheet iron, rendering it less liable to rust or tarnish than shafting of the ordinary finish.

4th. It will not spring or warp in key seating, like most other manufactured shafting introduced into the market, and, as a consequence, is admirably adapted for line and counter shafting.

5th. The peculiar manner in which it is finished gives it a surface composed of magnetic oxide of iron, thus forming a journal surface unequaled by any other shafting, no matter how manufactured.

6th. The process of manufacture is such that none but the very best stock can be used. The use of an inferior stock would entail positive loss to the party manufacturing it.

The circular gives the names of a large number of prominent machinery establishments, both East and West, who are using this shafting. E. P. Bullard, 14 Dey Street, New York, is the General Agent for New York City and the Eastern States.

Iron Review.

NEW YORK, Sept. 9, 1880.

The iron market continues in a satisfactory state and the demand is good. Values have not materially changed since our last report.

It should be borne in mind that the quotations for rails are for American iron, to the consumer in small lots and delivered at tide-water, which includes a freight. The other quotations are also for small quantities.

Pierson & Co., 24 Broadway, N. Y., under date of Sept. 9, 1880, quote prices out of store as follows:

Iron Rails, $50 to $53, according to weight; Fish Plates, 2¾c. per lb.; Railway Spikes, 3¼c.; Bolts and Nuts, 3½c.; Common Bar Iron, 2.4c., basis from store; Refined do. 2.6c., basis; Ulster, 3.6-10c. basis; Machinery Steel, 6½c.; Best Tool Steel, 13½c.; Norway Bar Iron, 6¼c.; Norway Shapes, 6¾c; Nail Rods, 6¾c.; Sheet Iron, 3½c., basis; Angle Iron, 3¼c.; Tee Iron, 3¾c.; Band Iron, 3.4c.; Hoop Iron, 3.6c., and up according to size; Horse Shoe Iron, 3.5c.; Hot Polished Shafting in lengths, 2 ft. and longer, 9 to 10½c., according to size; Small Black Rivets, 30% off in papers; 10% off in bulk.

Carmichael & Emmens, 130 Cedar St., New York, quote prices of Boiler Makers' Supplies from store as follows:

Flange Iron	5½
C. H., No. 1, Shell Iron	4½
C. No. 1 Iron	4¼
Tank Iron	4
Sheet Iron	3¾
Angle Iron	3½

Boiler Tubes at 40 per cent. discount off list.

Metal Review.

LUCIUS HART & CO., 8 & 10 Burling Slip, New York, furnish us the following, under date of Sept. 9, 1880:

No changes of importance in metals during the last week. There is a fair jobbing demand. Pig Tin has declined a little in price owing to a greater decline in London where *speculation* has been rampant for a few days. With a good demand here for consumption and the stocks on hand and afloat steadily decreasing, the price of Tin is firm and it is thought must steadily advance to the end of the season. We quote London for Malacca and Straits, £83; Singapore, $26½; here 30c.; Banca Tin, 25c; Australian and Billiton, 19¾c. to 20c.; English, 19½c. to 20c.; Pig Lead, 5½c.: Antimony, 16c. to 17c.; Spelter, "Bertha," pure, 8½c.; Western 5½c.; Silesian, 6c. Solder, No. 1, 11½c., "Half and Half," 13½c. Bismuth, $2.50 to $3.00.

WANTED.

Wanted.—A Superintendent for a foundry and machine works now employing 67 hands. State class of work been accustomed to, and reference fully. Address Geo. R. Lombard & Co., Augusta, Ga.

Wanted.—A young gentleman as draughtsman. Must be a graduate of Stevens Institute of Technology, or other school of engineering. Address Superintendent, 91 Turner Street, Grand Rapids, Mich.

Wanted.—A first-class machinist as foreman, to oversee 40 to 60 hands in a shop doing a general jobbing business and building engines. Address with references, Superintendent, 91 Turner Street, Grand Rapids, Mich.

An experienced machinery iron works Superintendent wishes to engage with reliable parties. Address, P. H. L., care AMERICAN MACHINIST office.

A Practical Machinist and Engineer, having many years experience as draughtsman and foreman, desires a situation in a shop or mill. Address, Cold Chisel, AMERICAN MACHINIST office.

A machinist wants a situation; experienced in building French Wire Nail Machines and manufacturing all kinds of wire nails. Address K. C., care AMERICAN MACHINIST, 96 Fulton St., New York.

We will pay (for Charles Lanster Defiance, Ohio,) one dollar each for Nos. 1, 3 and 11, of Vol. I AMERICAN MACHINIST. AMERICAN MACHINIST Publishing Company, 96 Fulton Street, N. Y.

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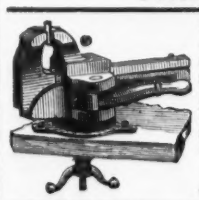

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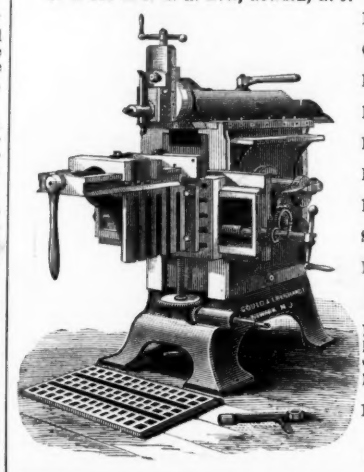

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No. 1,	¾	inch	$ 35
" 2,	½	"	40
" 3,	¾	"	50
" 4,	1	"	60
" 5,	1¼	"	75
" 6,	1½	"	90
" 7,	1¾	"	1 00
" 8,	2,	"	1 10

Small Set, $5.60.

No. 9,	2½	inch	$1 35
" 10,	3	"	1 50
" 11,	3½	"	1 70
" 12,	4,	"	1 90

Full Set, $12.00.

5 inch Dog	3 00
6 " "	4 00
¾ inch Dog	35

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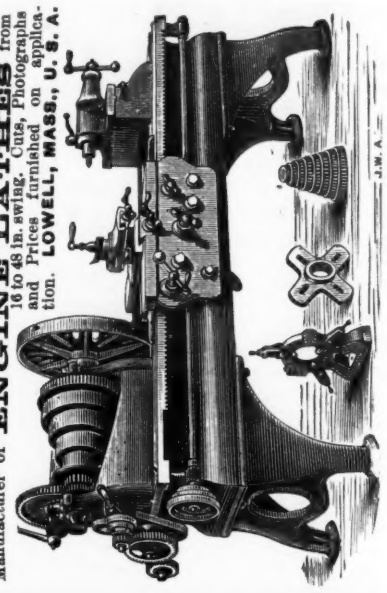

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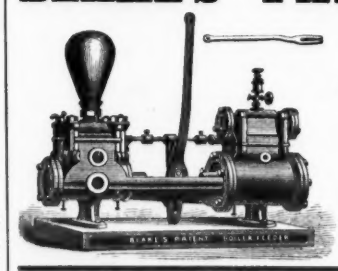

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Patent Hot Polished Shafting.

This shafting commends itself to the trade generally as superior to any shafting ever before introduced to the market for the following reasons, viz.:

1st.—It is perfectly straight and round.

2d.—It can be rolled accurately to any desired gauge.

3d.—It has the beautiful blue finish of Russia Sheet Iron, rendering it less liable to rust or tarnish than shafting of the ordinary finish.

4th.—It will NOT SPRING OR WARP IN KEY SEATING like most of the other manufactured shafting sold in the market, and, as a consequence, is admirably adapted for LINE AND COUNTER SHAFTING.

5th.—The surface is composed of MAGNETIC OXIDE OF IRON, forming a superior journal or bearing surface.

6th.—It is made of superior stock.

Price lists, with references and other information, furnished on application to us.

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Or to our Agent,

E. P. BULLARD, 14 Dey Street, New York City,
General Agent for N. Y. City and other Eastern States.

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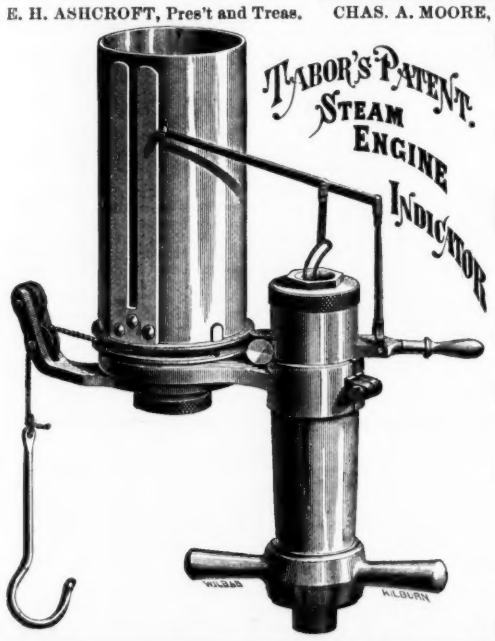

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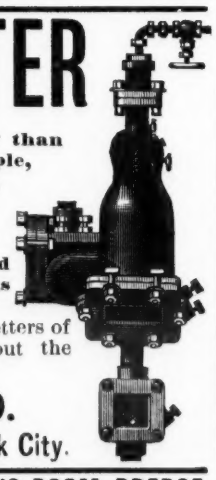

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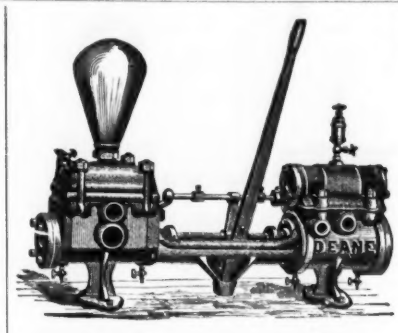

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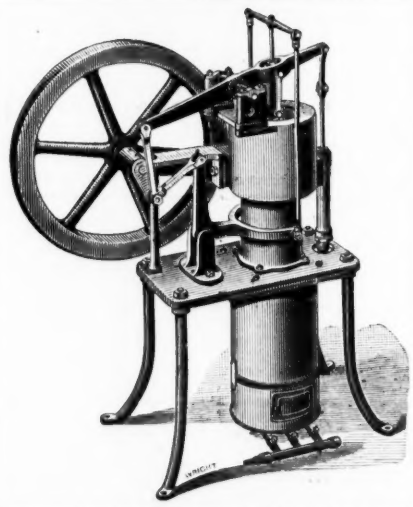

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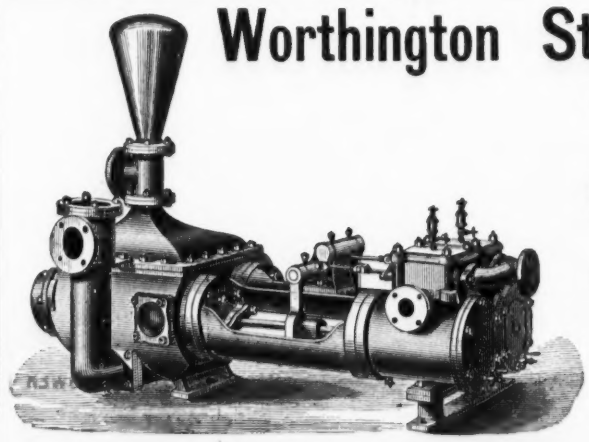

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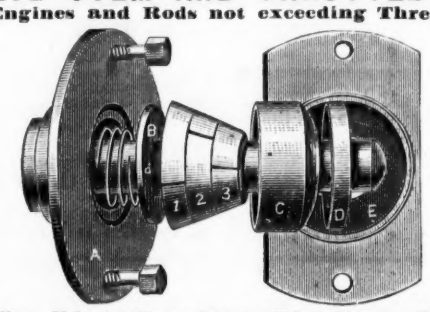

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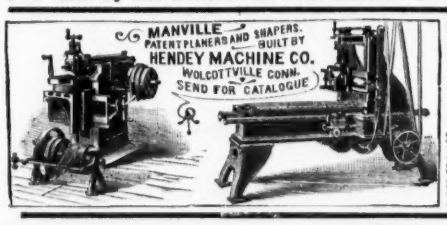

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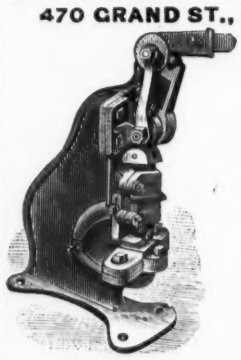

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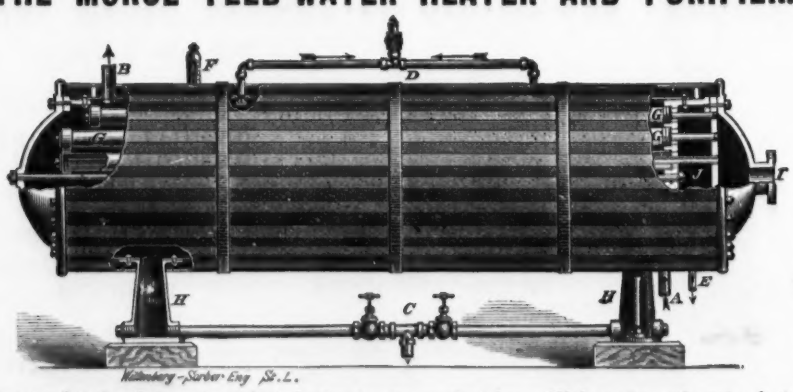

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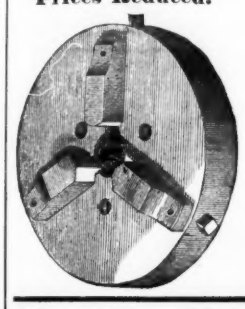

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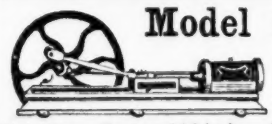

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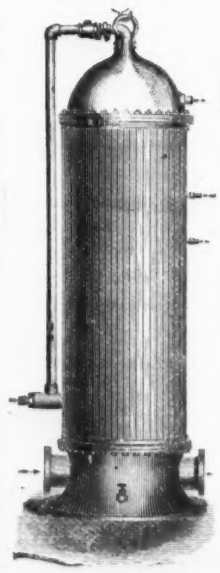

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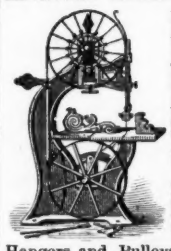

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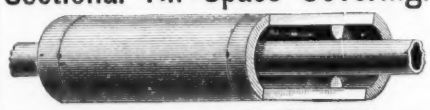

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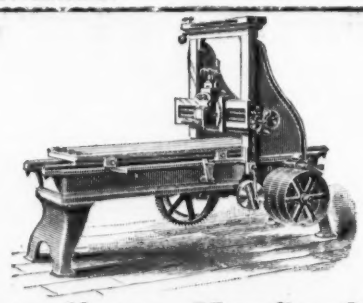

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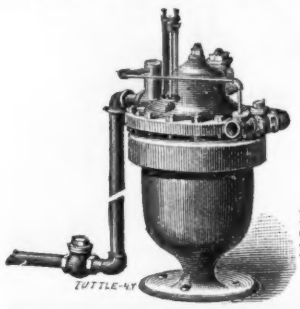

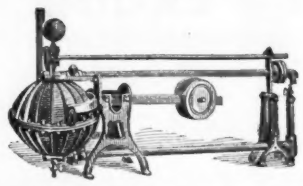

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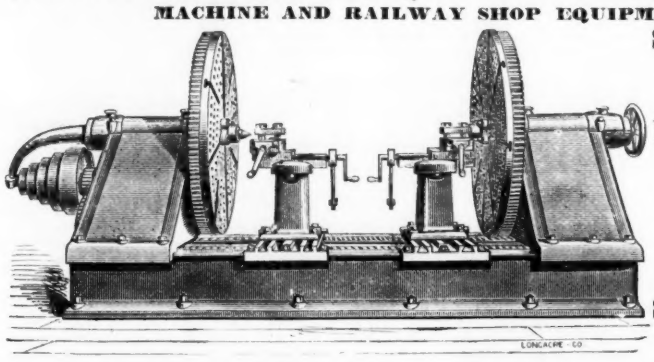

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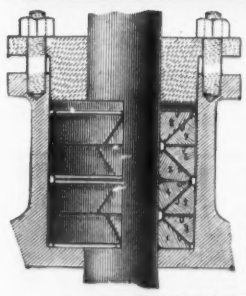

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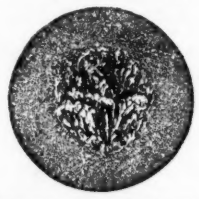

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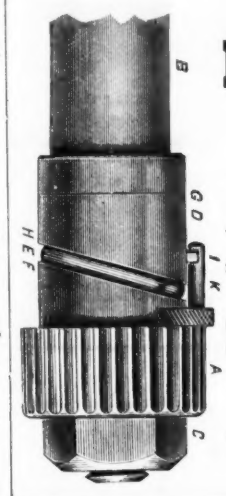

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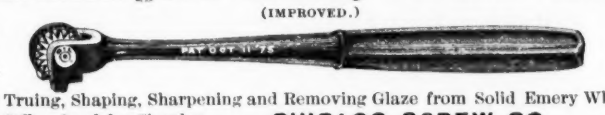

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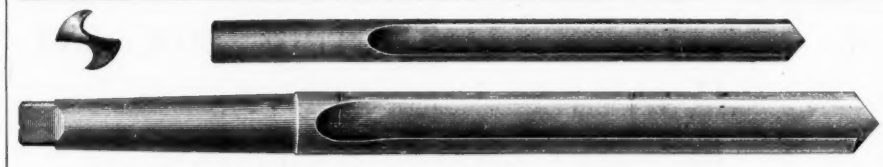

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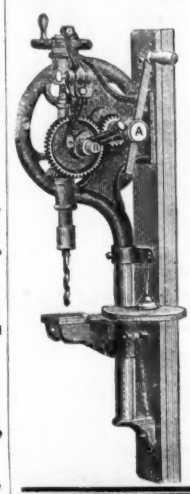

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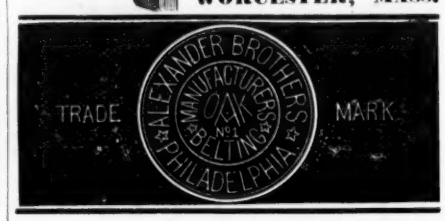

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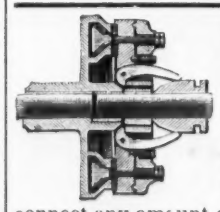

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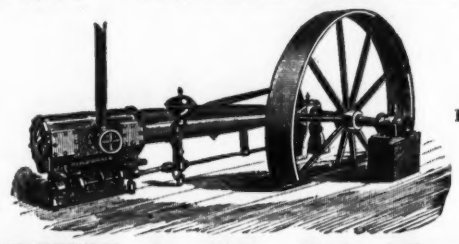

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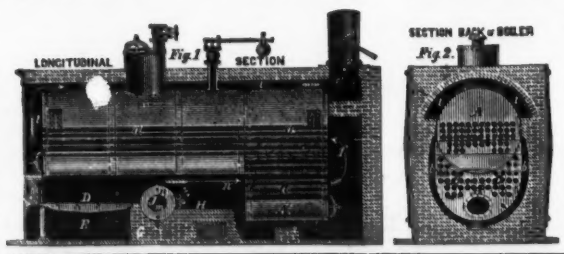

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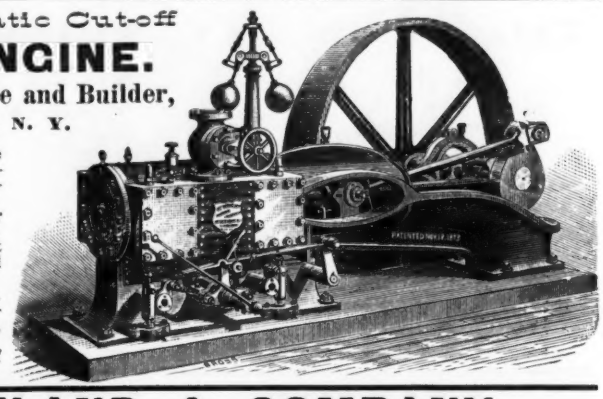

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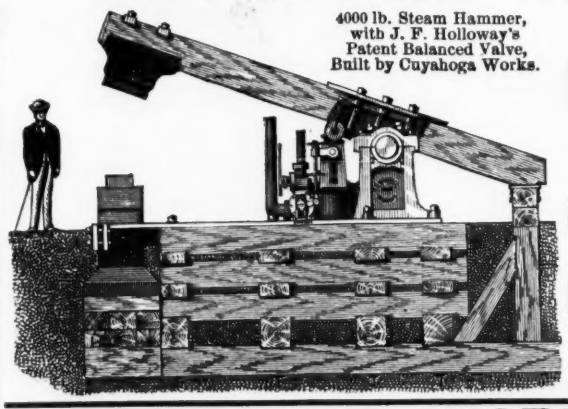

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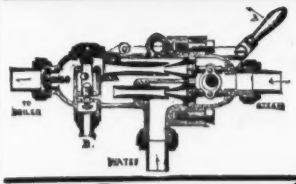

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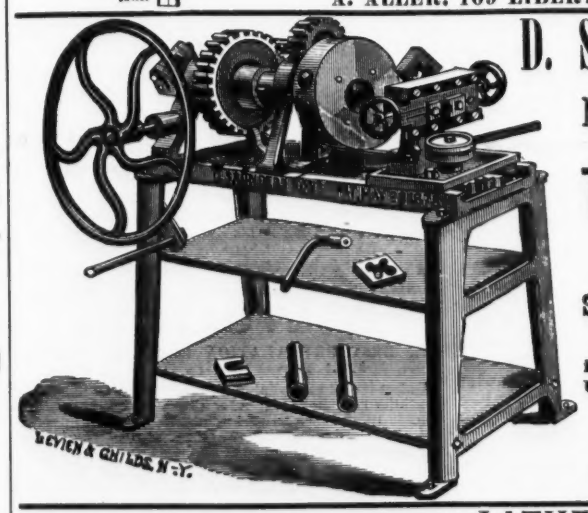

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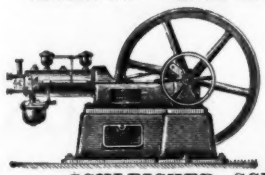

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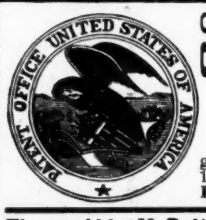

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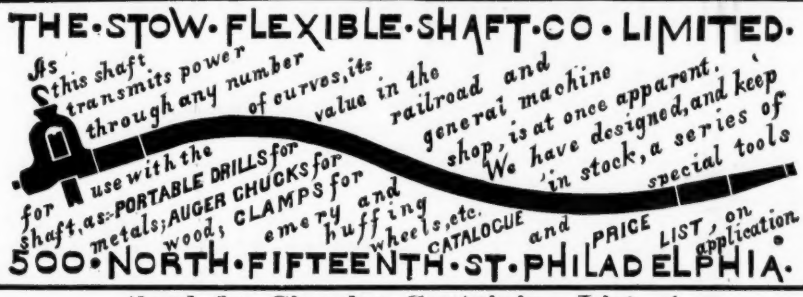
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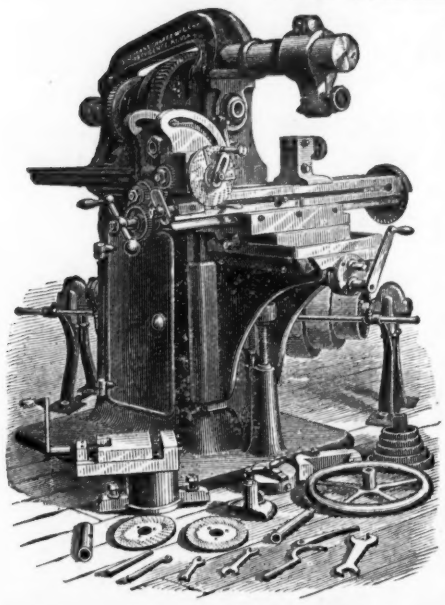

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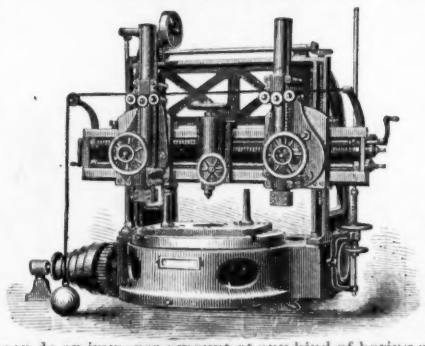

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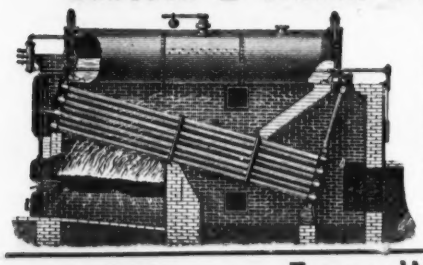

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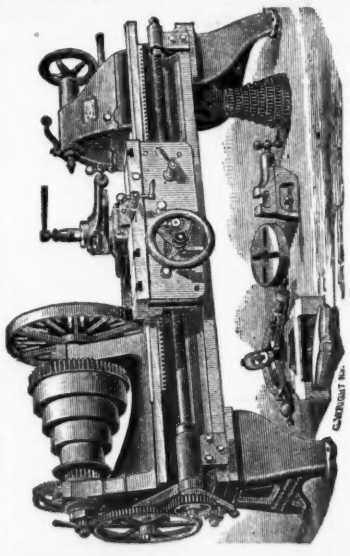

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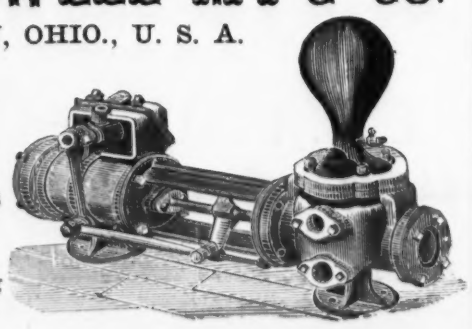

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